The Foundry Trade Journal

AND

PATTERN-MAKER.

THE OFFICIAL ORGAN OF THE BRITISH FOUNDRYMEN'S ASSOCIATION.

Vol. 8. SEPTEMBER, 1906. No. 57.

——PUBLISHED——

THE FIRST WEEK IN EACH MONTH BY

EAGLAND & Co., Ltd.,

165, STRAND, LONDON, W.C.

Devoted to the interest and advancement of the Iron, Steel and Brass Foundry Trades.

Subscription Terms: 7s. 6d. per annum, post free.

To place the "Journal" within the reach of Working Moulders and Pattern-makers the Proprietors will accept subscriptions, not less than three in number from one shop at the reduced rate of 5/- per annum, such order to be countersigned by the superintendent or foreman of the shop as a guarantee of good faith.

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THE FOUNDRY TRADE JOURNAL,
165, Strand, London W.C.

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BRITISH FOUNDRYMEN'S ASSOCIATION.

Third Annual Convention at Middlesbrough.

By kind permission of the Governors, the third annual Convention of the members of the British Foundrymen's Association was held in the Lecture Hall of the Middlesbrough High School, on Tuesday and Wednesday, August 7 and 8, 1906.

MR. BUCHANAN, the retiring President, took the chair, and said: Gentlemen, I have pleasure in welcoming you to this meeting. It will be a source of pleasure as well as pride to you when I announce that Professor Turner is with us. His name is known not only in Britain, but all over the world as a distinguished metallurgist, especially in cast iron. It was with very great pleasure that I heard he was in Middlesbrough. He will, no doubt, be able to impart to us some of that abundant knowledge which he possesses. Before proceeding further, we will take the minutes of last meeting.

The SECRETARY read the minutes.

The PRESIDENT: Those who consider these minutes accurate will kindly signify by holding up their hands. The minutes are adopted unanimously. The Secretary will now read apologies for absence.

The SECRETARY read apologies for absence from T. Westgarth, C. Jones, Cardiff, and Wm. Roxburgh, Kilmarnock.

The PRESIDENT: I am sure all of you along with me regret that Mr. Tom Westgarth is unable to be with us owing to his not being so well as could be desired. We will now take the Secretary's report.

The SECRETARY then read his report.

MR. ELLIS (Southampton) and MR. NEWLANDS (Stockton-on-Tees) moved and seconded the adoption of the report.

The Next Meeting.

The PRESIDENT having declared the report unanimously adopted, said: The Secretary has mentioned a matter which I think we might discuss now. That is, the question of fixing the places of meeting for the future. The Council has felt

it difficult to gauge the feelings of the members and the capabilities of the various places at which we should meet. We should be glad to know whether you prefer to decide now, or as in the past, leave the matter in the hands of the Council to select two or three places and then leave it to the vote?

MR. PILKINGTON: I should like to say with regard to this matter that there is one very great difficulty that is sure to crop up very shortly, and that is as to the time of year. We shall soon have exhausted all the places at work during Bank Holiday week, and it will become a question then whether the time of year of meeting should not be altered. We should move with considerable care in the matter. Members should express an opinion both as to the place of meeting and the time.

The PRESIDENT: We might discuss the question as to whether it is desirable to fix a place now, or leave it until later on, and the Council choose places and submit them as before.

A MEMBER: It would be very well for the Council to choose places and send cards round. It is quite a democratic way and one everybody ought to be satisfied with. With regard to meeting in Bank Holiday week, I think we should hold on to it for a year longer.

Another MEMBER: Personally, I should like to have the matter decided by this meeting. There are one or two things in connection with the present system—expense, etc. In other institutions and associations, at one annual meeting the place is fixed for the next. That is a usual thing to do in many societies, and by doing it we would save trouble and expense. We have not yet exhausted all the places we might visit in Bank Holiday week where works are working. How would it do to take Birmingham, as having had the next number of votes to Middlesbrough, to select that for our next meeting?

MEMBERS OF THE B.F.A. AT MIDDLESBROUGH.

Another MEMBER: Has our Secretary any names of places available during Bank Holiday week? That is, places of interest open.

A MEMBER: I think that is one of the most important things we should consider first.

The PRESIDENT: I should like to ask you for your names as you speak. It will assist the Press very much.

Another MEMBER: Personally, I think the old way has proved very successful, and I do not think we can do better, although I am a member of the Council, and perhaps should not make the suggestion. We might fix upon a place now that might afterwards be found to be altogether unsuitable both for visits and other reasons, and it would be very hard for

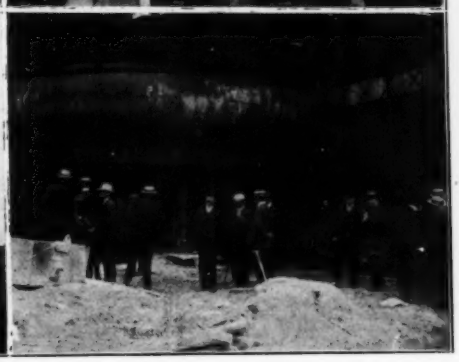
the Council to have to rescind the minute passed at this meeting. As to the question of alteration of date, there are not many places in England where people are at work on August Bank Holidays. If we started on the Monday, we would find that most firms were closed for one or two days. As it is, the inconvenience of the holiday is not felt by the members. It works very well so far as I am concerned. As far as Birmingham is concerned, it would be altogether out of the question to meet there August Bank Holiday. I do not think you would find a single foundry at work before the Thursday, at all events. We could have no visits, and that is one of the events of the Convention. Personally, I should be inclined to fix the place as previously, that is, by the Council selecting one or two places and submitting them to the members. For the time I think we should have to be guided by the place selected, and then we might take a vote of the members as to whether Whitsuntide would be suitable for meeting. There are not more than a third of the members present, and it would not be wise to bind the remainder by a decision come to here to-day.

THE HIGH SCHOOL MIDDLESBROUGH WHERE THE MEETINGS WERE HELD.

BLAST FURNACES. BOLCKOW, VAUGHAN & CO.

MR. ELLIS GIVING A FEW FOUNDRYMEN A WRINKLE IN FRONT OF THE GRAND HOTEL.

GROUP OF MEMBERS INSPECTING BLAST FURNACES AT BOLCKOW, VAUGHAN & CO.'S WORKS



MR. FINCH: I should like to disabuse the minds of the members about the cost of getting the votes in. It only runs to a penny per member, and the expense is practically nil.

A MEMBER asked if there was any reason why they should limit the annual Convention to places in England. Why not go on the Continent?

Mr. Butler moved that the matter be brought forward at another meeting, to allow the Council time for consideration. This was seconded and carried without any amendment being put forward.

Another Member asked with regard to the time, if they could not fix up amongst those present to decide upon Whitsuntide?

The President: My opinion is that such a suggestion is too premature to come before us this morning for a final decision, because one has to get the feeling for and against a meeting at Whitsuntide. I think if the matter mentioned was introduced at a future meeting it would give the members an opportunity of making up their minds and deciding what would be best, and coming to a definite decision, say, at the next Convention. Personally, I quite agree with the proposal. I feel if this meeting did come to a decision to-day there are good chances that it would be wrong. With that expression of my own opinion we will pass on to the next business.

Mr. F. J. Cook.

Mr. W. Roxburgh.

Mr. Thos. MacFarlane.

Mr. Herbert Pilkington.

Mr. J. G. Stewart.

The New Officers.

The President: I have great pleasure in proposing as my successor to the Presidency, Mr. H. Pilkington. I have had the honour to appear as President before you on two previous occasions, and I take the greatest possible pride in saying that I had the honour of being the first President of this Association. That the position has been an onerous one in some respects is true, but I have been recompensed by your extreme kindness, and by the educative advantages which I, myself, have been able to gather. I quit the Presidential chair without any feeling whatever of fear for the future, with such a President as Mr. Pilkington will prove himself to be. As regards his qualifications, I may only mention that he is a Past President of the South Staffordshire Iron and Steel Institute, and a member of the Iron and Steel Institute. He has also written somewhat largely on cast iron, and will no doubt prove himself an ideal President, both as a business man and as one who is learned in science on the subject. Without further remarks I have much pleasure in moving the election of Mr. Pilkington as President of the British Foundrymen's Association.

Mr. MacFarlane (Horsehay, Salop) seconded, and the motion was carried unanimously, amid applause.

Mr. Herbert Pilkington, on taking the chair, said: I thank you very much for having elected me President of this Association, and I can only assure you that, though it will be a difficult task to emulate my predecessor, still I shall do everything I possibly can for the benefit of this Association. It is likely to do a large amount of good, and I am sure I may count upon the assistance of the members just in the same way as they have extended their assistance to Mr. Buchanan. Whilst I am on my feet I think I ought at least to propose a hearty vote of thanks to Mr. Buchanan for his able occupancy of the chair. He has worked most strenuously to make the Association a success, and I think it will be extremely difficult to emulate him. I beg to move a hearty vote of thanks to Mr. Buchanan.

Mr. J. M. Fletcher (King's Lynn) seconded, and another member supported.

The motion was carried with acclamation.

EWART.

MR. BUCHANAN: I have to thank you. I can assure you what I have done has been a labour of love. I had some hesitation at first when asked to help to start this Association, because I was very full of work in other directions, but like many others, I have found that it is the busy men who have the work to do, and so my two and a half years of Presidency has brought me a great deal of pleasure along with a great deal of work. In the future it will be a sweet recollection to me that I have been engaged in this good work that we have all been engaged in with. I think, something more than a personal interest. I have little doubt that most members of this Association have joined not for what they are going to get out of it, nor even for what they are going to learn from it, but many of us have to some extent a patriotic motive. We recognised that our country, of which we are all so proud, was not keeping up to the point of perfection that it ought to keep up, and that we were too apt to let things drift, believing that nothing could make us take a second place. I do not believe, either personally, or as a citizen, my country should take second place in any way whatever. So it was with that in my mind, with ambition to hope that I should help on this good work, that in the foundry world at least we should bear our own like men. So we fully believe that this Association is having a marked influence on the particular industry with which we have been, and are now, connected, and we intend going on until we help more and more the foundry interest of the country with the knowledge and science that are available. The scientific side is as highly developed in the iron industry in this country as in any country. It is also true that many of our foundries—at least numbers of them—are second to none in the world: but it is also true that there is a large substratum—a large number of foundries—which are not what they ought to be, and not what they can be, and it is really to convince many of our foundrymen that they do not know all they ought to know—it is with that object in view that we are working now. That this Association will go on and continue to do good work and elevate the industry is our ambition. Even as a private member of this Association I am willing and content to do my duty in the future as in the past, so that our industry may go on to better ends and hold its head up proudly fearing none whatever.

THE PRESIDENT: The next business is the election of a Vice-President.

MR. MASON (Birmingham): I have very much pleasure in proposing Mr. F. J. Cook. Coming in contact with him very much, I have found he is a very enthusiastic foundryman. He is not afraid to tell us—as I am afraid so many of us are—what experience teaches. I think he will make a very able President when his time arrives, and I have much pleasure in proposing him as Vice-President.

MR. SPERRING (Portsmouth): I have pleasure in seconding. I endorse every word our friend has said with regard to Mr. Cook.

THE PRESIDENT: I am sure I cordially agree with every word that has been said. He will make an excellent Vice-President. You have heard the proposal.

Mr. Cook was then unanimously elected.

MR. COOK thanked the members for honouring him by electing him Vice-President. He appreciated fully the honour and responsibility, and would do everything in his power to further the interests of the Association.

In proposing that Mr. Finch be re-elected Secretary and Treasurer, MR. BUCHANAN observed that as they were no doubt aware, there was a great deal of work in connection with the position, and only with that love of work in his heart could he possibly tackle it.

MR. ELLIS seconded, and the resolution was carried unanimously with applause.

MR. FINCH, in reply, said: I hardly know how to thank you for the manner in which you have received my name as Secretary and Treasurer. You would have adopted a more wiser resolution if you had got someone else as Secretary. There is no doubt I have made the office a labour of love. Some years ago I felt that such a thing as this Association was wanted in England as well as America. It was with pleasure I saw the correspondence which took place in the FOUNDRY TRADE JOURNAL, and I followed it up, and the result has been the Association. Sometimes I got some letters that practically set my back up a little bit. In thanking them in conclusion, Mr. Finch said he would give the very best of his abilities to the British Foundrymen's Association.

MR. PILKINGTON: I have much pleasure in now introducing to you the Mayor of Middlesbrough.

The MAYOR OF MIDDLESBROUGH (Councillor T. R. Dent) was introduced by the President, and in an address of welcome remarked: I am pleased to have the privilege of coming here this morning to offer you a hearty welcome as Mayor on behalf

of the citizens and people of Middlesbrough. We are pleased to see and receive good practical men here to deliberate. It is by such as you and kindred Associations that information is disseminated which is useful to us and also for the good of the whole community. I am pleased to welcome you here, and I hope you may go away having seen something of Middlesbrough which may be to your advantage, and I hope that you may leave some information behind which may be useful to us. Do all that you can for us. Leave us as much knowledge as you can, but take whatever there is in the district. I am pleased, indeed, as Mayor, to welcome you, and I hope your visit will not be an only one. That your Association will be successful is my earnest wish and the wish of those who like to see Associations of this description disseminating knowledge for the advantage of friends and also giving information which they feel may be of some use to the world, not only during their time, but to those who have to follow. I cannot say how pleased I am to see you in Middlesbrough. You might not see many beauty spots in the town, but still we have some beautiful districts around us, so that while we have disadvantages they are compensated for in feeling that we have a fairly prosperous district, and by the utilisation of the resources around us—largely brought to a success by practical men like yourselves—we have a good deal to be thankful for. You have gathered from different parts of the country. Birmingham may know some things better than we, but we have some things in Middlesbrough which may interest you, and you are welcome to it all, but leave us something behind. On behalf of the people of Middlesbrough I offer you a hearty welcome.

The PRESIDENT: Mr. Mayor, as President of this Asociation, I thank you very much indeed for extending to us such a cordial and hearty welcome to Middlesbrough. Perhaps there are not many beauty spots in this immediate neighbourhood, but I recollect very well that you have a most beautiful park out here which I have visited. This town always appeals to anyone who has anything to do with the iron trade or engineering trade. It is the most progressive town in the country. I am heartily glad the Mayor has saved the time to come and see us and welcome us so kindly and heartily to Middlesbrough. We thank you very much.

The next business is the election of Council. I will read the names and take them *en bloc*, unless some objection occurs. Mr. R. Buchanan (Walsall), Mr. C. Morehead (Rugby), Mr. P. Longmuir (Sheffield), Mr. J. Ellis (Woolston, Hants), Mr. W. Vickers (Birmingham), Mr. J. G. Stewart (Urmston, Lancs.), Mr. T. McFarlane (Horsehay, Salop), Mr. W. Roxburgh (Kilmarnock), Mr. R. Mason (Birmingham), Mr. Chas. Jones (Cardiff), Mr. G. P. Varley (St. Helens, Lancs.), Mr. Bagnall (Sheffield). I move the election of these gentlemen as members of the Council.

MR. FLETCHER seconded, and the motion was carried without dissent.

The PRESIDENT: There is another matter before I go on with my address. The rules that have been drawn up were published in our last year's proceedings, and perhaps instead of going through them to-day we might take them as read, and pass them as the substantial rules of this Association. I therefore formally move that the rules as published become the rules of the British Foundrymen's Association.

MR. BUCHANAN: I have much pleasure in seconding that.

The MAYOR OF MIDDLESBROUGH: I must ask you to excuse me. I have a meeting of the Agricultural Society of the Yorkshire Show to attend, and I am compelled to deny myself the pleasure of listening to the President's address. I hope your Society will prosper, and that we shall have the pleasure of again seeing you pay a visit to Middlesbrough.

The PRESIDENT (after a show of hands): I now declare the rules passed.

MR. H. WINTERTON (Birmingham): May I venture to call your attention to a matter which, with your usual diffidence, you have overlooked. That is a vote of thanks to the officers of the Association, of whom you are one. I am quite a junior member, but I have been brought into contact with several members. The late President will probably remember how hard he had to work when he went to inaugurate a meeting at Cardiff. Torrential rains were experienced, but notwithstanding that there were 200 people to inaugurate a meeting at Cardiff. As the junior member, Mr. Finch gave me every assistance he could. When he heard that I, like himself, was a Gloucestershire man, he welcomed me, and said he would be glad if I could introduce any more members. I have just returned from America, and I can only liken him to the energy one sees displayed there. I have very great pleasure in proposing a hearty vote of thanks to the officers of this Association for their services during the past year.

MR. KENNEDY seconded, and the motion was carried.

MR. FINCH: I am rather pleased with our friend's remarks that he thinks I am of the American style. A good deal of push. It has been by push and push and push that we have made members. I have been heartily assisted by every member of the Council, and when I tell you that one of the members specially comes all the way from Southampton to Birmingham to attend the Council, you will see that some are willing to do the work of this Association. I heartily thank you.

The President's Address.

The PRESIDENT then delivered his address.

MR. MATHER (Ashford, Kent): I think we should pass a very hearty vote of thanks to our President for his able paper. We, in Kent, see very little of the iron district. In the early seventies I was working in Sheffield. Since I left Yorkshire I have seen very little, about London and the South of England, of the iron industry. As regards the Kent industry and the Sussex industry, it may be interesting to some to know that as far back as 1500, cannons were made for the French Government. I have in my possession some old firelocks which the Americans in particular are anxious to get hold of. They are dated 1600. I have one dated 1649, which was made in Kent. I beg to move that we pass a very hearty vote of thanks to our President for his able address.

PROFESSOR TURNER: I should like to second. We do not propose to discuss it, nor do we say that we agree with everything you have said. You have given us matter for consideration, and we are much indebted to you.

The PRESIDENT: I thank the proposer and seconder. Professor Turner seemed to suspect that I should say something he would like to criticise. It is a time-honoured custom that the President's address is not discussed in most societies, nevertheless, I have not the least doubt that I shall get plenty of personal criticism from Mr. Turner himself. There is considerable difficulty with regard to the names. If you will kindly give your names it will be a great convenience.

MR. P. MUNNOCH (Middlesbrough) then read his paper as follows:—

Grading Pig-Iron for the Foundry.

The PRESIDENT: Gentlemen, I am sure you will agree with me that this paper displays a very great deal of ability. It is now open for discussion. Speaking as one who has had to do a good deal with pig-iron, I should say it displays an appreciation of the situation greater than I have yet seen. Gentlemen, I shall be glad if you will discuss the paper.

PROFESSOR TURNER: As you all understand, there is a good deal in detail in this paper that we cannot discuss fully this morning. I join with you in saying how interesting it is. It shows a great deal of practical knowledge of the situation. The ideal is that the founder should know the complete chemical composition of his metal, the mechanical properties of that metal, and that he should know the grade of the metal, but in practice, of course, we cannot carry out these ideals always, because of the time and expense. I understand the author of the paper is trying to give us what he thinks might reasonably be obtained from the iron producers at the present day. We should scarcely gather from the paper, in the first place, that there is what we might regard as normal composition corresponding to grading. If we take Cleveland iron, we have a normal composition for each grade. It is not the same with hematite iron, and it is particularly different from what we get with American iron. If we know, as ironfounders, the source of our iron, we ought to know the percentage of phosphorus and the amount of manganese, and the author no doubt is assuming that, because he does not refer to these matters except incidentally. Where furnaces are running on mixed ores it is as well to know what the phosphorus is. Grading on fracture might help them with iron made at the same works with similar ores from known sources, but what about mixed ores bought from various localities in small parcels? Even with irons from ores of known qualities, what is to decide the grade of fracture? Where there are small parcels of ore in Staffordshire, there is found considerable differences in phosphorus. What is it that determines the grade? The most important is the size of graphite. If we know the size of graphite, we know the grade of the iron. What is it that causes the graphite to separate out of various sizes? Two elements. Largely silicon, and the next is sulphur. Every addition of sulphur makes the iron smaller. In other words, it closes the grain. The closed pig-irons, he says, may be classified as fairly high sulphur, and may be 0.04 to 0.06 of sulphur. I have analysed it, and always found it rather high in sulphur, 0.14 or 0.15. The author

refers to the fact that too much silicon is a great disadvantage, and he mentions that particularly in reference to large castings. There is no doubt that too much silicon is a disadvantage. The essential point in foundry practice is the right proportion of silicon for the particular purpose you have in view. A great element to which he attracts our attention is sulphur, and he has done us a good service. We cannot here give it the attention it deserves. My observation is that roughly it requires something like twenty parts of silicon in iron originally fairly well balanced to counterbalance the effect of one part of sulphur. If we take the proportion of sulphur as indicating the grade, we do not go far wrong. The temperature at which the iron is made has a considerable effect. Take some pure iron and carbon, and take the lowest temperature you can get, say, 1,100 degrees, only a small amount of carbon, and white iron will result. Heat it and it becomes greyer and greyer, and ultimately it becomes a No. 1, although you have no silicon and sulphur left. The size of the graphite which separates out first has a good deal to do with the appearance, but the separation may take place at temperatures as high as 1,100 degrees, or as low as 900 degrees, and the fracture will be different. The low temperature will present a finer grain than the high temperature. The higher the temperature of the blast furnace, the coarser will be the grain of iron produced, other things being equal. I have quite enjoyed hearing the author's paper. He has given us ideas which I am sure we shall all find interesting and of practical use.

Mr. Buchanan, dealing with grading, said: For myself, it will have an enlightening effect if the distinction had come first, but the use of the term grading has been used so many times that I cannot get into my mind what the author of the paper means by the term. The term grading is one of those things which appear all things to all minds. When Mr. Munnoch talks of No. 3 grade containing 1 per cent. of silicon, and No. 1 grade containing 3 per cent. of silicon, I have great difficulty in bringing to my mind what that iron will look like when I see it. As regards this endeavour to fix a system of grading which I still maintain is a charming kind of endeavour and to my mind is really a barring of what to the foundryman had become an absolute necessity, and that is, a fixed definite something by which he was going to judge of what he was buying, and what he was going to use. We should look round for methods by which we are to buy iron other than by grading, so long as we have such an object-lesson before us in the hands of the steel-makers. Why does the steel-maker not buy by grade? Does he call his irons by No. 1, 2, 3, or 4? I suppose he does, but after all, he buys by analysis. Now what is sauce for the steel-maker's goose is food for the ironfounder's gander. As long as the steel-maker finds that his analysis paid him, and it is his only possible way of carrying on business, he will use it. It is very simple to take the pig-iron maker's numbers, but I want something more definite, and until we get that, I for one am not going to be happy. That is my position. I for one am not one who is going to compromise on names, and they may call it No. 2, 3, or 4, or anything they like. What is your analysis? Till they give us an analysis we do not know what we are having. I suppose blast furnace people must make up their minds that they are going to give something more definite than numbers of grades. They will have to give an analysis so that one will know what they are buying and using. The numbering of 1, 2, and 3 is at present the greatest bar that is existing in the country to the advance of the foundry industry. The numbers are supposed to describe the certain constitution of the iron. Now it is well known that you can alter the grade of iron by slow cooling. If one man runs pig-iron into the bed and wants it quickly, he waters it, and may call it No. 3. Another man runs into the sand beds and covers up gently with sand and lets it cool slowly, goes into the market and realises a better price, but it is of no more value to the ironfounder than the other. The numbering of pig-iron is simply for the greater part deceptive. So I am one who goes for analysis out and out. Take the steel-maker. He found it a necessity, and I hope to-day the foundrymen also find it a necessity. Now, the blast furnace people are not at all fond of giving analysis, though they use the chemist to analyse the ores and other materials they use, but not on many occasions do they analyse the pig-iron. I think that is rather giving the case away. Why blast furnace people should analyse the materials they received, and then stop there, to me is rather suggestive, and I think we foundrymen must blame the blast furnace people to some extent. They try to get on our innocence—(laughter)—and think that we are a little simpler than I think we ought to be considered. So

far as I know, there is no system of grading or numbering which will protect the ironfounder against such doings, but he may protect himself by analysing his irons. So that while thanking the author for his interesting paper I must disclaim having any dealings with anyone who endeavours to set up a go-between, and endeavours to preserve buying by fracture; Whether called by numbers or any other name, I am no friend of it. I shall use all my influence to get founders to introduce analysis. I do not maintain that it will tell one everything, nor will metallography, but it tends to give founders an active knowledge of things in which they were dealing.

Mr. Percy Longmuir: I am afraid, Mr. President, I cannot contribute much to this discussion. Mr. Buchanan has very well expressed my own feelings. Analysis after all is such a simple thing that we look to nothing further. A complete analysis is not such a costly affair, and grading by complete analysis can easily be done. If any change in grading is adopted, grading on a chemical basis would solve a lot of the difficulties met with, and it can be easily followed.

Mr. Whitwell (Middlesbrough): I agree with Mr. Buchanan as to grading. I, as a steel maker, do not believe in grading by fracture, but I have a check upon that by analysis. There is a method of casting pig-iron coming into use, and I think it will come more into use than at present, and that is, by doing away with the sand beds and casting by machines.

Mr. Riches (Beccles) asked the author if he thought the chill cast pig-iron would come back to the better grain of the sand cast pig-iron.

Mr. Finch said he was speaking the other day to an ironmaster, and he said they could not afford to pay a chemist to analyse the iron. One small employer could not afford it, but by combination in the different districts they could compel makers to sell by analysis.

The President: The discussion which has taken place seems to show what very great sinners the makers of pig-iron are, but I think it is not properly appreciated that the analysis of pig-iron but imperfectly represents the bulk of pig-iron that is there. After all, pig-iron is only a crude material and not a finished one, and blast furnaces have not yet attained the perfection necessary to produce a finished material of constant absolute regularity. Selling by analysis will not solve the troubles of the ironfounder, and his percentage of wasters will not be reduced. The purchase of iron for steel-making is not a good comparison. There are no physical qualities involved in the use of pig-iron for steel-making, but in the foundry the physical question assumes a larger importance, in my opinion, than that of chemical composition. Mention has been made of machine-cast pig-iron, but I do not think it is due to pig-iron makers that so little of that iron is made, in fact most of them would be delighted to deal with their iron in that fashion, but ironfounders will not have it. If analysis only is what pig-iron has to be bought by, what I want to know is, how is it that foundries will not have machine-cast pig-iron?

Mr. Munnoch, replying to the questions said that with regard to American iron being lower in sulphur, that was not his experience. He had found that some of the iron was as bad as British irons, and varied just as much. With regard to glazed iron he had glazed forge, as well as glazed ordinary iron. Glazing was due to the low total carbon, iron with high total carbon would take more silicon to give the glazed appearance. Mr. Buchanan wanted to abolish grade, but grading was really the foundation of the prices of the different qualities. Grading told the quality, and as long as the foundrymen wanted to distinguish, they would have grading to some extent. Mr. Buchanan had asked about the fracture of iron with 1 per cent. and iron with 3 per cent. silicon. I have seen irons practically similar in appearance which had these different silicons. Why did the steel-makers go by the analysis? Their requirements were different altogether from the founder who required something else besides the iron. The steel-makers required only the metal iron. Where the steel-makers did buy by analysis the foundrymen got the iron that did not suit the steel-maker. (Laughter.) But I do not say that the iron which does not suit the steel-maker is not suitable for the founder. It depends entirely upon the class of castings you are making. Mr. Buchanan wants analysis only and no grading, but I am afraid that is not likely to come yet a bit. The blast furnace people cannot make iron to analysis, not to within narrow limits. Mr. Whitwell had asked something about chilled cast iron. Anyone selling chilled cast would have to sell by analysis. Mr. Riches had asked if chilled cast would come back to the same as sand cast iron. Practically it would. There would be no difference after the iron was melted and put into the

castings. The result would be identical as far as my experience goes.

On the motion of the Chairman a vote of thanks was accorded Mr. Munnoch for his extremely interesting paper.

The meeting then adjourned for luncheon, and in the afternoon the members visited Messrs. Bolckow, Vaughan & Company's Eston Steel Works.

Messrs. Bolckow, Vaughan & Company's Works.

At Messrs. Bolckow, Vaughan & Company's Cleveland Iron and Steel Works, Grangetown, much that was of great interest to the party was shown. The blast furnaces, of which there are six groups, or twenty-five furnaces in all, with twenty in operation, were fully explained. The three mechanically charged furnaces were another feature of the tour. At this works, Cleveland, hematite, spiegeleisen, and ferro-manganese are produced. The steel works where the following processes are carried out—acid Bessemer, basic Bessemer, and acid and basic open-hearth—provided room for keen inspection by the visitors, great interest being taken in the work of production. There are two metal mixers of 150 tons capacity; ten converters, each with a capacity of 8 to 15 tons; eight open-hearth furnaces, each with a capacity of from 20 to 60 tons; one 48 in. blooming mill for rails, etc.; one 60 in. slabbing mill for plates; one rail mill for ordinary rails from 40 to 100 lbs. per yard; one mill for street tram rails up to 120 lbs. per yard; also steel sleepers, joists, and merchant sections; small mill for fishplates, light rails, etc.; two plate mills, one capable of turning out plates from $\frac{3}{8}$ in. to 3 in. thick by 108 in. wide, and rail finishing department completing the large steel-making plant of this large firm. The greater part of the auxiliary machines in the steel and iron works are electrically driven, the current being three-phase alternating, and supplied from the Company's own power station. The total output of finished steel at the works is 234,000 tons per annum, the men employed being about 12,000.

After the conclusion of the tour a vote of thanks for the kindness and cordiality shown by the members of the firm and officials was unanimously carried.

Wednesday's Meeting.

The members re-assembled on Wednesday, August 8, 1906, when the President took the chair.

The PRESIDENT: I will take Mr. Roxburgh's paper first. Mr. Buchanan, in Mr. Roxburgh's absence, has kindly undertaken to read it.

MR. BUCHANAN: I may as well explain that this paper will be as new to me as it is to you, because I have not read it myself yet.

Mr. Roxburgh's paper was then read.

The PRESIDENT: We are sorry the author of this paper is not here, but I trust you will give it plenty of discussion. Under our present arrangement it will be quite possible for the author to reply in writing. The paper is now open for discussion.

MR. MEYER: Mr. President, from the founder's point of view I think the author has put the thing so tersely and plainly that there is hardly anything to discuss. Mr. Buchanan said he was getting on to dangerous ground, but we still think that we should take the advice of the foundryman. I myself am engaged on a class of work where there are various ramifications of the construction, and I many times wish that I could get our engineers and designers to understand and believe that there is a natural law called expansion and contraction. It might be the means of avoiding many disasters which take place in connection with large castings. It is a plain, practical paper, and I think it will form an important part of foundry literature.

MR. MASON (Birmingham): I am sorry to disagree with Mr. Meyer, but I must say I think very little of this paper. Mr. Roxburgh speaks of shrinkage and contraction as if they were the same things, and goes on to discuss the bending of castings and shrinkage holes as if they were both due to the same cause. I think it would have been better had he followed on West's lines, who talks of shrinkage as that which takes place before solidification, and contraction as that which takes place after solidification; then we could have followed his ideas more clearly. Mr. Roxburgh says there is more trouble with shrinkage holes in soft metals than in hard metals, but I don't think that is so, and we all know that the steel and malleable-iron moulder has more trouble with shrinkage holes than the grey-iron moulder; yet it is a common saying among the grey-iron moulders that shrinkage holes are due to soft iron, or are more common in castings when the iron is soft. I think this mistake arises from the fact that castings with shrinkage holes are often softer than castings from the same pattern which have no shrinkage holes; but that is not due to softer metal, but to the rate of cooling from the casting temperature; a casting

poured dull (at a low temperature) will cool quicker than one poured hot, therefore will be harder and will have less time for the eutectic to separate or liquate to the heavy parts, and as the formation of a eutectic is the cause of shrinkage holes, we have less shrinkage holes in castings which are hard owing to quick cooling, and we have more in castings which are soft owing to slow cooling and not because the metal with which they were cast was soft. In my practice I find we have most trouble with shrinkage holes when we have to charge our cupola with more pig-iron to a smaller amount of scrap than usual, and with the first iron from the cupola; or, in other words, with metal which freezes or solidifies at a low temperature; but if I can add a pig rich in manganese, or add manganese to the molten iron, thus causing the metal to solidify at a higher temperature, I have no trouble with shrinkage holes, although the metal is quite soft. In regard to the twisting and bending of castings during cooling, I know every foundry foreman is troubled with that at times, but that is due to unequal rates of cooling after solidification, and if our castings were the same thickness throughout, and we could gate them so that the casting would cool evenly in all parts, and thus contract regularly from the middle outwards, our castings would not be bent. In my experience in the stove grate trade, when making plate-patterns about 42 in. long by 24 in. wide, with the plate and pattern cast in one piece, the thickness will vary in several places from $\frac{5}{16}$ to $\frac{1}{2}$ in., and owing to the unequal cooling, due to this variation of thickness, the plates were always bent unless the mould was cambered to allow for it bending in cooling. The plate, even after cambering, was often waste, owing to either too much or too little camber being allowed, and a plate often had to be made twice before one straight enough to use could be cast, and sometimes a plate would only be in use one or two days before springing into two pieces because of the strains existing in the casting due to irregular cooling. Now, I never camber a plate, no matter how irregular it is in thickness: I make the mould as near dead straight as I possibly can, and about twelve or seventeen minutes after it has been cast I strip the casting clear of sand for a space of about 12 in. square in the middle, and gradually cool the plate evenly from the centre towards the edges, so that contraction begins at the middle and finishes evenly outwards, the edges being last. By thus assisting and regulating the cooling I never have a plate bent, and the strains in the casting are reduced to a minimum.

PROFESSOR TURNER: The subject you have introduced to-day is one of very great importance to ironfounders, as you all realise. We are met at once with the difficulty of definitions, in connection with this subject, as to what we mean by shrinkage and contraction. There has been a good deal of difference in American writers, and apparently a wide difference of opinion. We have had given by Mr. Mason the view of Mr. West. Mr. Keep, who is perhaps the best known authority, has adopted a different definition. When I speak of expansion and contraction, I mean those changes with which we are familiar in ordinary metals and ordinary materials. Take, for instance, the iron rail. It is heated to a moderate temperature and expands. It is cooled and exactly regains its size. The same way with a gas. There is no difference from what there was before. Now take a piece of clay in the damp state to dry it. After drying it you bake it. You will find while it was drying it contracted. It will not recover its original volume, so that that is shrinkage. The difference in volume from the original to the final we call shrinkage. We take no account of plus and minus. There are some pluses. We take the net result, and we call it shrinkage. The author says metals shrink according to their density, but that is not correct. Lead is a dense metal but its shrinkage is small. Metals shrink as a rule according to their melting point. The higher the melting point the more do they shrink. Steel shrinks more than cast iron, and cast iron shrinks more than the majority of metals with a low melting point. Shrinkage also depends upon the size of the casting. A thick bar of cast iron will shrink less than a thin bar. The first careful measurements in this direction were made by Keep. In tests at the Birmingham University we allow the metal to run into one bar $\frac{1}{4}$ in. square, and at the same time, everything the same, we cast a $\frac{1}{2}$ in. bar. This bar has four times as much metal in it as the other. You practically never find the two bars have the same length. On comparing the bars, it would be found that the $\frac{1}{4}$ in. iron had shrunk more than the $\frac{1}{2}$ in. But it is not a universal law of nature that a thin bar will contract more than a thick

bar. If you take the case of copper, it is the reverse. If you take brass, in some cases the thin and the thick bar contract at the same rate. So that evidently this is a question worthy of considerable study by the ironfounder. At the same time it can be studied without any expensive apparatus. In the first place a shrinkage test shows you the softness of your iron. As soon as you have an iron that shrinks much, you know you have a metal that is hard. With pig-iron, if you do not wish to trouble with analysis, the simplest way to ascertain what it will do in the foundry is to melt six or seven pounds, and then pour it into a shrinkage test. One other interesting point with grey cast iron is expansion during solidification; if phosphorus is met with, you get a further expansion. During the first few minutes the iron is gradually getting bigger, and then it goes back to its original size, and then goes on contracting. The shrinkage curves have been classified and give much information. Mr. Mason referred to internal contraction in iron that is too soft for the purpose. The interior of these holes are rough. You will find other holes which are smooth, and are very often dark-coloured, or nearly black. These are usually due to the iron being too hard, and very often the presence of sulphur. A good founder when he sees the hole in the casting, should know what is the matter. While I do not altogether agree with a number of statements that the author of the paper has made, we are indebted to him for bringing before us a very important subject for foundry work.

Mr. F. J. Cook: This is a very interesting subject, and worthy of every foundryman's following up. I have given a great deal of attention to it, and I also disagree with the terms that are given. I generally say sinking and shrinkage. They do not always follow. You get irons which will give you exactly the same shrinkage. Test them in what I call my K test, and one will be found hollow and spongy. Others will be quite solid. It is a big source of trouble to a man who has to make special casts without special iron. The analysis may be right, the chemical analysis right, but still it gives trouble. With this K test I am able to eliminate a good deal. The analysis and shrinkage give them both of the same quality. I had a great deal of trouble with the castings until I got this K test, when I was able to find out. The question of shrinkage is an exceptionally good one for lots of things, but you have to be very careful between the thick and the thin bar. I have done a great deal of testing, and I test every day, but I cannot find any law to govern it. I have a series of tests from 0.151 shrinkage up to 0.2. I cannot form any real law for it at present, but there are rules, of course, to which you can work very nearly. If you follow Keep's rule, and keep near it, you are bound to be right. With reference to the sinking bars, that is a matter which draughtsmen cannot always get over in designing. You have to have thick bars and thin bars. Although we quite agree with the writer, we have a good deal to complain of from the draughtsmen. It is the part of the foundryman to devise means to get over their troubles. A great many of these troubles can be got over by controlling rates of cooling. Chills are one of the best things to eliminate trouble. A chill introduced into a mould sometimes works wonders. Then the writer of the paper gives a very good hint as to bars that have to be polished. My experience is—and what I always follow—that the castings should be taken out of the moulds as soon as possible after casting. Not too hot to get them hard. It gives you a much easier polishing surface than allowing them to cool otherwise. I should have liked the author to have given us some more practical hints as to how to deal with shrinkage. Perhaps he will include that when he replies to his paper.

Mr. Longmuir (Sheffield): Mr. President, I have been very interested in listening to this paper. Professor Turner mentioned the fact that shrinkage was a function of the melting point. Some time ago I made aluminium, lead and steel castings side by side. The difference in the melting point is 700 degrees. I found that lead does shrink. To me it seems better to regard shrinkage as liquid contraction, and to regard contraction as occurring entirely in the solid. I do not see that there can be a vacuum. If a hole is there, there must be gas in it.

Mr. Buchanan: I agree with Mr. Longmuir. He has been more exact and definite than anybody we have heard this morning. In the Birmingham district we talk about a liquid contraction as sinking. The Scotchman talks of it as drawing. After the metal has taken solid form we call that contraction, of course. I believe there are many differences of opinion as to the causes of sinking or drawing holes. In the foundry, one often hears a great deal of difference of opinion as to whether a certain hole is a blow hole

or a sinking hole. When one sees the hole with a light shining surface, I usually put that down to blowing. When it is dark, I put it down to sinking or drawing. Where the shrinkage hole is dark the gases from the coal are entered into that hole, and so darken the interior, just as the exterior of the casting is darkened. I think everybody has been avoiding a question which the author has raised—warping. I make bold to say that there is no subject whatever connected with foundry practice about which less is known. It is one of those things of which I know profoundly little. Other people are chary of saying as to how a shape is going to come out. It is a subject of enormous interest to the foundryman, and I should say also it would be a matter of the greatest possible profit, if one could clearly predict how a casting is going to come out when it has been cast. It is a rather difficult thing predicting what it will be when cast, simply from the fact that our ideas of crystallisation and of contraction are in a very elementary stage at the present moment. As to why a thin casting should contract more than a thick one, in the heavy casting you have the larger crystallisation and the larger graphite, which occupies a definite position, which means it contracts less. Until we know more about this subject we are likely to be confounded by shrinkage holes, cooling of castings, and warping of castings. No man, or very few indeed, could predict with any certainty how they are likely to come out of the sand.

The PRESIDENT: I am sorry this discussion must come to a close. I was very glad Mr. Longmuir laid down his definition of contraction and shrinkage, with which I quite agree, and I also believe it practically agrees with Mr. West. I should like to have heard more of the relative shrinkage of hard and soft metals. I should just like to allude to a point, and that is the relative responsibility of pattern-makers and foundry managers. I quite agree with the author of the paper that whatever the pattern-maker has to say, the Foundry Manager ought to lay it down finally how the pattern is going to be made. That carries the responsibility with it, but it is the principle I have laid down in my own works. I hope this subject will be brought up in some further paper. I move we accord Mr. Roxburgh a hearty vote of thanks for this paper.

A MEMBER: I suppose we are to understand that this paper will be further discussed in the "British Foundryman's Journal"?

MR. FINCH: It will be sent to every member.

MR. T. SWINDON then read his paper.

The PRESIDENT: I hope in the discussion of this paper you will be as brief as possible.

MR. BUCHANAN: I, for one, do not feel competent to discuss pyrometers, but I thought a little story connected with the mirror galvanometer used with them might interest this meeting. Somewhere about twenty years ago a party of students were in Lord Kelvin's house in Glasgow—he was then Sir William Thompson. He had the students in his drawing-room, and he saw a number of them looking at an illuminated address on the back of the drawing-room door. He said, "You are examining that address?" "Yes, sir," was the reply. Lord Kelvin said, "There is a little story attached to that." The address was from the shareholders of the first American submarine cable, thanking Sir William for his efforts in making the submarine cable a success. Sir William explained that when it was first mooted to lay the cable, the directors did not fail to paint the prospects as very rosy. Lord Kelvin had taken them to task in the newspapers, pointing out that what they were proposing to do, and what they said they would do was impossible with the stage that science had arrived at at that time. They were very cross. When the submarine cable was laid, they found they were not able to read any messages that came by it. The instruments were too crude, and would not record. As Lord Kelvin was then the most eminent man in that line, as he probably is to-day, seeing he had been falling out with them before, the shareholders did not like to go to him. So he said: "A very great lady wrote to me and asked me what I could do." He set about and invented the appliance which recorded the message. It is an interesting story, as it links the revered name of our late beloved Queen Victoria with Lord Kelvin.

MR. LONGMUIR: The author has given a very good paper on the various methods of measuring temperature. Now, what is the good of it to us? That question was asked when analysis was first brought up, and when the microscope was introduced. A good part of my work is with special steels, and in certain of them without the pyrometer or some method of measuring temperature, the work would be hopeless. The practical value of temperature measurement is to be found in replacing empirical methods by exact

ones, and it is specially evidenced in the case of steel and steel castings.

MR. MAYER: I should like to know if he has ever applied it to manganese bronze? There is a test condition in connection with it. It is a somewhat difficult matter to get. I should like to know if he has applied the instrument, and at the various stages of heat.

MR. E. ADAMSON (Seaton Carew): Mr. Swindon has given us a very good paper indeed—it shows the grasp he has of the use of the pyrometer. I do not, however, think he has done justice to the optic instruments. He will, no doubt, remember using the "Wanner" with me when taking the temperatures of some of my tests at the Sheffield University, when we found the difference between that and the Le Chatelier amounted to only a few degrees. I have since used another optic pyrometer, and it is very easy of manipulation. With regard to the intricate pyrometers generally. I think foundrymen will ask: "What is the use of these if it will take ever so long to get a temperature?" What he wants is to get this quickly, and he can do this with an optic instrument. I am sorry, therefore, that greater stress was not laid upon these. Of course, for annealing purposes where a record is required the matter is different.

The PRESIDENT: Time is progressing, and I think I must ask Mr. Swindon to reply to this discussion. With regard to my own use of the pyrometer, I have used a good many in taking temperatures of hot blast and gases, and I finally settled on the Roberts-Austen pyrometer, which is a thermo-electrical pyrometer, and is arranged at Sheepbridge to record automatically at a considerable distance from the furnaces and also close to the furnaces themselves, by means of a galvanometer fixed there any reading can be taken at sight by switching on the particular furnace required to be read. This has been in use for some years, and has been a source of very much increased regularity in our blast furnaces. We not only get a record of temperature, but what the men are doing during the 24 hours with regard to charging and the changing of stoves.

MR. SWINDON: With regard to manganese bronze. I have not had any experience in this line, but they are used for steel which does equally well. With regard to Mr. Adamson's remark, he misunderstood me if he thought I said the optical was open to error. It is no more so than an electrical instrument. Of course, they all have their advantages and disadvantages. One has to be standardised every morning, another has not. Each one is thus suitable for one particular line, and I hope when the need is provided, it will enable anyone interested to pick out the instrument which he thinks most suitable to follow up the line in which he is working. No one instrument can be expected to cover the whole of the measurements necessary, and one has to specialise on the instrument he thinks best.

The PRESIDENT: I am sure you will accord a hearty vote of thanks to Mr. Swindon for his most valuable contribution. I will now ask Mr. Houghton to briefly read his paper.

MR. E. HOUGHTON (Chesterfield) then read his paper entitled—

Notes on the Chemistry of Cast Iron.

The PRESIDENT: The paper is now open for discussion.

PROFESSOR TURNER: There are a good many points upon which I should like to have an opportunity of speaking after I have read the paper more carefully. With regard to the exudations which the author names. My attention was first called to that matter quite twenty years ago by the late Sir Frederic Abel, who had observed this at Woolwich, and had kept some samples. They were very pretty, and principally sulphide of iron. Some years afterwards I saw exudation in the form of phosphide. You will find that phosphorus will come out and leave spongy iron. A great deal of the phosphorus will come out like little peas. The author referred to the extreme importance of microscopic examination. Very few people know how ancient such an examination is. Those of you who have read Réamur's book will find that he, in 1720, used the microscope for the examination of steel. In one of his drawings he gives us the structure of a mild steel which is not at all unlike the ferrite and the perlite. The drawing shows us this in a very marked way. The only advance we have met is the application of geological methods. In the office of a foundry it would be very easy to introduce a microscopic outfit at a comparatively small price. I think that for about £20 you could get everything that is necessary for a founder. A man can learn to use this and train his eye for microscopic examination quicker than for any other ordinary method of testing, and it is easier than learning analysis. I am looking forward to the time when practically all foundries will do their own shrinkage tests and microscopic tests, and probably send out when they require analysis.

MR. E. ADAMSON (Seaton Carew): Like Professor Turner, I should like to see the paper before speaking at any length, as

so many points are raised. I recently completed some experiments which shows the effect of manganese. The total carbon was 3.40, Si. 1.05 to 1.08, S. .04, P. practically .50, the results were:—

—	Chill.		
Mn.	True chill.	Spotted white.	Mottle off.
.613	¾ in.	1¾ in.	2¼ in.
3.250	1¼ ,,	4 ,,	—

Fracture behind Chill.—Hard grey, inclined to mottle above 4 in. lower chill meets the atmospherichill from top.

The C.C.—taken from the fracture behind the chill—in the first sample was 0.74, and in the second 2.10, which clearly shows the hardening influence of Mn. Manganese imparts heat, and should, theoretically, from *this* point of view, incline to the formation of G.C., but Mn. has a direct influence in holding the C. in combination, thus increasing the C.C. The metal for my tests was melted in crucibles and poured into a $6 \times (2 \times 1\frac{1}{2}) \times 5$ chills, but if the metal when melted were left *in* the crucible and allowed to cool very gradually, I can quite understand Mn. seemingly turning white iron grey, but the true cause, if ferro-Mn. were used, would be temperature, otherwise slow cooling, as the metal would remain for a longer period at the recalescence point of graphite. Of course, if spiegel were used instead of ferro-Mn. the addition of silicon as well as Mn. would explain such results.

Mr. Cook: Can the author give some idea how to produce or govern the castings against small grain carbon? It is of the greatest importance to all present.

Mr. Mayer: Mr. Houghton alluded to the great improvement brought about by the mixer. What kind of lining was there in the mixer, and how long was the process of desulphurisation?

The President: I will now ask Mr. Houghton to reply.

Mr. Houghton: I shall not detain you any longer than is absolutely necessary. The paper was written quite as much with the object of eliciting information as giving it. I have been much interested in listening to the brief debate, and I am very much obliged to Mr. Turner for his remarks. I quite agree with him on the importance of microscopic examination in the foundry. We do not pretend to argue that all the difficulties of the foundry will be solved by microscopic examination any more than as chemists we assert analytical work will do it, or mechanical testing, but the whole three should go together, and have their proper place. With regard to Mr. Adamson's remarks, my own tests have not been sufficiently extended for me to be dogmatic at all in the matter. With regard to Mr. Cook, I can suggest no better method of finding out how to do this than that he should procure a copy of Mr. Pilkington's paper last year, and study that. Mr. Mayer talks about the mixer. I referred to the one at Cargo Fleet, which you will have an opportunity of seeing for yourselves this afternoon. The metal is not injurious to the lining.

The President: I am sure we all thank Mr. Houghton for his very interesting paper. Before we depart from this business meeting I think I ought to propose a vote of thanks to the Governors of the High School for having so kindly placed this room at our disposal, and all the facilities there are here.

Mr. Buchanan: I have much pleasure in seconding that. We ought to thank the Governors for their kindness in placing the room and school at our disposal.

The President: I think we should tender our best thanks to Mr. Stead and Mr. Westgarth and those other gentlemen who have kindly assisted the Secretary in getting us facilities here and helping with the arrangements. They have done everything to make the meeting a success.

Visit to Cargo Fleet.

In the afternoon more than ordinary interest was centred in the visit to the works of the Cargo Fleet Iron and Steel Company, Limited, the plant, etc., being of, perhaps, the most extensive and up-to-date character in the country. The party was conducted to the blast furnace plant, consisting of five stacks and blown by five engines. The two modern furnaces, 90 ft. high, were thoroughly explained, the equipment calling for special attention. Seven gas blowing engines of the Cockerill type delivering 14,000 cubic feet of free air at 10 to 12 lbs. per square inch are spanned by a three-motor 20-ton crane. At the gas washing plant was seen three Theisen gas washers, two being able to deal with 1,800 cubic metres per minute, each washer being driven at a speed of 310 r.p.m. by a 150 b.h.p. Brown Boveri motor. Six Babcock's and one Nesdrum water-tube boilers for supplying steam to a 1,000 h.p. turbo generator, coke oven plant, and the Brown hoists were also inspected. The pyrometers of the Callender type, the gantry and ore bins, coal washing plant, and the Kopper's coke ovens

were seen at work. In the electric generating station there was a one-compound steam direct-driven set of 350 kw., one steam turbo generator set of 750 kw., and two Premier gas engines, each directly connected to two 300 kw. generators. The Company's requirements for two blast furnaces are about 7,000 tons per week of ironstone. The steel plant, all of the most modern type, was also visited, and in the smelting shop were two 175-ton Talbot furnaces, the gas being supplied by ten Talbot mechanically-stirred producers. One furnace platform was seen, a Wellman electrically-driven charging machine, two 40-ton hot metal cranes, and a 75-ton steel casting crane. The operation of casting was witnessed by the party, another interesting feature being the examination of the rolling mills and the finishing mill, which is spanned by a 60-ton crane.

The visitors also inspected the works of Messrs. Richardsons, Westgarth & Company, marine and general engineers, boiler makers, etc., Middlesbrough, and here again an interesting survey of the works was conducted. The firm built steel works plant, gas engines of large size, tilting furnaces, etc., the cogging and finishing mills, with their 18,000 i.h.p. engines at the Cargo Fleet Works being constructed by the firm. A great variety of work was seen in progress, including marine engines, quarter-crank blowing engines, including one of 1,000 i.h.p. for dynamo work to use blast furnace gas, having two double-acting tandem cylinders 29½ in. diameter by 35½ in. stroke, to run the 20 revolutions. Another engine was of 900 i.h.p., for driving a ventilating fan for the Powell-Duffryn Coal Company, South Wales, to use waste gas from coke ovens, while a third, nearly completed, will be of 1,500 h.p., with four double-acting cylinders of 25½ in. diameter and 31½ in. stroke, to run the 20 revolutions, the shaft between the two cranks to carry a 50 ton flywheel. In the boiler shops were seen marine boilers for 180 h.p. working pressure, about 16 ft. diameter each, weighing about 50 tons, also various other work, including a 200-ton Talbot patent tilting furnace for Messrs. Palmer & Company, Jarrow, and others for the South Durham Steel and Iron Company.

The works of Messrs. Cochrane, Grove & Company were also inspected by a number of the visitors.

For the group photos, etc., accompanying this account we are indebted to Mr. T. MacFarlane, of Horsehay, Salop, a member of Council of the Association.

CORRESPONDENCE.

MOULDING AND CORE SANDS FOR PETROL ENGINES.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—We would be pleased to learn, through the medium of your journal, of the most suitable moulding and core sands, for casting fine work, such as petrol motor cylinders. We find the most trouble with the cores. Thanking you in anticipation, we beg to remain,

Yours, etc.,

J. J. H.

[We shall be glad to hear from our readers on this subject.—ED. F.T.J.]

REPETITION WORK IN THE FOUNDRY.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—I note, on reading the very interesting paper by Mr. Bonvillain in your last issue of the FOUNDRY TRADE JOURNAL, the special mention of importance to the method of making pattern plates and the apparatus employed. This has long since been accepted by all founders making repetition work, the only drawback being the great cost and time required by the old system, using split patterns secured to metal plates. For the information of your readers I would call attention to an apparatus made by E. White, of Redditch, which enables the moulder to produce a first-class pattern plate very quickly and without the aid of expensive tools.

Yours, etc.,

W. LITTLETON.

9, Fenchurch Street, E.C.

[We hope to publish shortly a description of the interesting apparatus to which Mr. Littleton draws attention.—ED. F.T.J.]

In the FOUNDRY TRADE JOURNAL for August we published an article entitled "Pattern Shop Equipment." It should have been stated that this paper was read before the American Foundrymen's Association in Cleveland. It was written or prepared by members of the Cleveland Club of Associated Patternmaker Foremen.

PIPE FOUNDING.

(*Continued from page* 344.)

By W. E. Cowens.

Pit pipes, as the name implies, are cast vertically in dry sand moulds. They are usually specified to be cast socket down with a head on the spigot end which has to be cut off in the lathe. Special plant is required which we propose to explain in detail.

Boxes.—The moulding boxes are made in various ways. Those now described are attached to bogies, and are moved on rails to the positions required for ramming, drying, casting, and emptying. Other methods will be discussed later when considering the most economical arrangement of the pit. For sizes up to and including 15 in. the boxes are usually double, as shown in Fig. 10, to give more stability in moving them. The amount of sand rammed round the pattern is $1\frac{3}{4}$ in., being the least that can be used for hand ramming. The box is made in halves held together with cotter bolts, and as the cotter weakens the bolt they are made oblong in section to give greater strength at this part of the bolt. The standard length of pipe is 12 ft., but in the smaller diameters 9 ft. is still required by some engineers, and to enable those to be made a joint is made just below the bell-mouth and a short length of box fitted, 3 ft. long; this enables either 9 ft. or 12 ft. pipes to be made as required. The metal in the box is 1 in. thick and the flanges $1\frac{1}{4}$ in. thick, vent holes $\frac{5}{8}$ in. diameter; 6 in. centres are cast in the body to allow free vent to the gases when casting. Two W.I. lifting eyes are cast in the top of each half box, to lift off the half box when emptying.

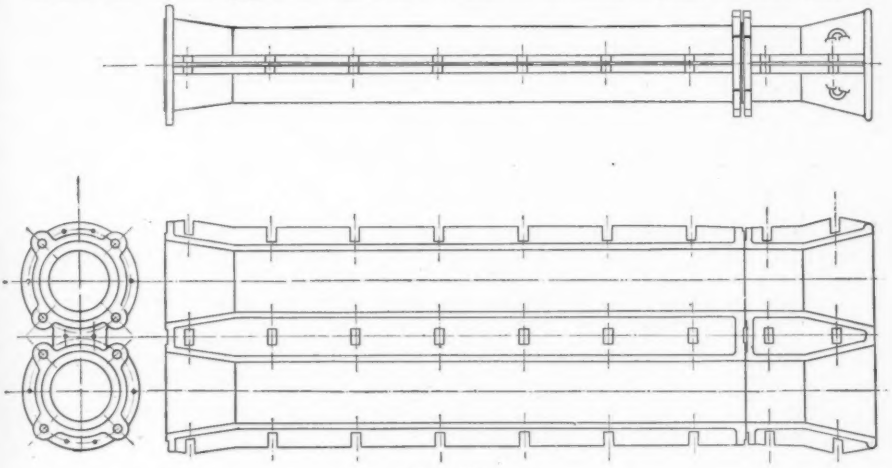


Fig. 10.

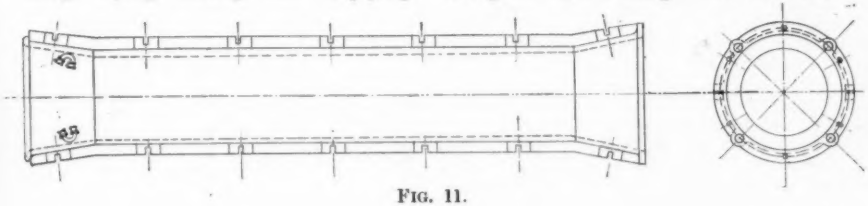


Fig. 11.

For the larger sizes, from 15 in. upwards, the box is cast in one piece in the length, as shown in Fig. 11. It is made in halves the same as the double box, and is held together with cotter bolts. The thickness of the box for the larger sizes

is 1¼ in., and the flanges 1½ in. to 1⅝ in.; vent holes are ⅝ in. diameter, 6 in. centres. The amount of sand rammed round the pattern is 2 in. The bell-mouth at the bottom should taper well up into the box to allow ample room for ramming the socket. The extreme length of box for a 12-ft. pipe, allowing for head

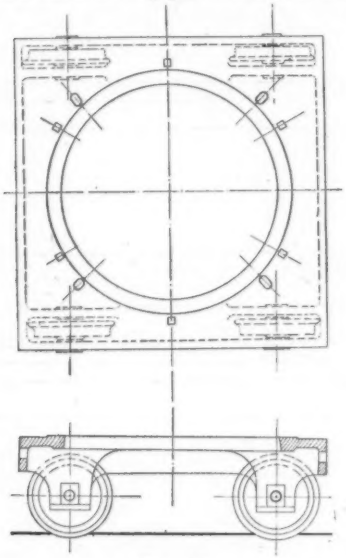


FIG. 12.

and runner, should be not less than 13 ft. 4 in. The joint in the box must be either chipped or planed to ensure a close fit, and the base should be machined to fit the bogie, care being taken to see that this face is at right angles to the axis of the box.

Bogies.—The bogie is of cast iron, set on four wheels, as shown in Fig. 12. One half of the box is permanently bolted to it through the square holes; the other half is held to this by the four oval cotter bolts, which also serve to hold up the socket pattern when ramming, and when this is withdrawn the casting plate and kellet when casting. The circular taper hole is carefully bored to gauge, and all casting plates and socket patterns turned to the same gauge so as to be interchangeable, any kellet or socket pattern fitting any box. The facings on the top and underside of the bogie are machined, the top to take the box and the underside to take the casting plate. In fitting up the bogie it is imperative that it be set on level rails, and all wheels given an even bearing so that there is no rocking, and that the facing on the top be dead level in both directions under those conditions when tested with the spirit level. The necessity for this is apparent, if it is remembered that the height of the box is about six and a half times the width of the bogie, and that ⅛ in. out of level on the bogie would throw the box nearly ⅞ in. out of plumb at the top. Unskilled labour is almost entirely used for making pipes, and to get over this difficulty I have seen the men wedge up the wheels to throw the box over, forgetting that they may only increase the difficulty if the fault lies in the machining of the box. Any faults of this kind should be carefully traced and corrected, as they invariably lead to faulty pipes.

The double bogie is not illustrated, as it is practically the same as the single bogie, on four wheels, but longer to allow for the double box.

Casting Plate and Kellet.—The casting plate is shown in Fig. 13 as used for the

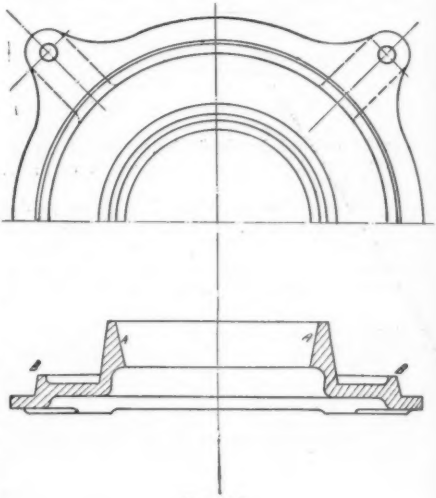


FIG. 13.

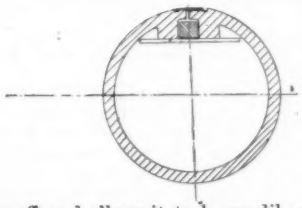
larger-sized plates. It is of cast iron 1⅜ in. thick, and has the kellet for carrying the socket mould cast with it. The kellet portion has a few ⅝ in. holes cast in it for vent. The taper portion A A is bored carefully to gauge and is concentric with the taper B B on the outer edge

which is turned to fit the bogie. The flange is also faced to fit close to the bogie when cottered up. These facings should be kept clean and clear of sand when in use. If the casting plate is tilted in fixing, the core-bar will not stand plumb and the pipe will be sided.

FIG. 14.

Core Spindles.—Core spindles are usually of two kinds, solid and collapsible. Fig. 14 shows a common type of solid bar, with flutes cast in to carry off the vent. This bar is first covered with a straw rope and then with the loam. The straw rope, after casting, gets charred, and as soon as the bar lifts

FIG. 15.



burns off and allows it to be readily withdrawn. The bar is fitted with turned spindles, top and bottom, to run accurately on the bearings whilst being coated, and the taper end is turned concentric with these journals to fit the taper portion of the kellet. A vent hole must be cast or drilled in these bars to prevent the expansion of the air, due to the heat in casting, from bursting them.

The collapsible bar is shown in Fig. 15. The object of these bars is to save the expense of straw ropes, and they are very effective for sizes above 18 in.; below this size, owing to the difficulty of fitting them up, due to the small space in the interior, they are seldom used. The body of the bar has a gap, similar to an ordinary piston ring, running the full length of the bar. It is covered by a thin plate, attached to one side, the other side being free. A series of wedges attached to a strong bar runs the full length of the core bar. Fig. 16 shows this bar; the stops at A A prevent it falling out when collapsed. To expand the bar it is driven up with a heavy hammer, the wedges shown in Fig. 16 coming in contact with taper pieces cast on the inside of the spindle and springing it out to its full diameter. It is then coated and dried ready for the mould. After casting, a few minutes are allowed for the metal to set, when a blow with a hammer on the top of the bar causes it to fall, and the bar collapses sufficiently to be withdrawn from the mould. The amount of loam on the bar is $\frac{3}{4}$ in. a side at the top, and nearly $\frac{7}{8}$ in. a side at the bottom, the body being cast with this amount of taper. The journals of this bar are turned true with the body to run in the journals when coating. The taper portion of the bar is not turned, but covered with a thin coating of loam at the same time as the bar is coated. The bars are all carefully balanced to turn freely. The amount of loam allowed on the fluted bar, including straw rope, is $1\frac{1}{2}$ in. to $1\frac{1}{4}$ in. a side.

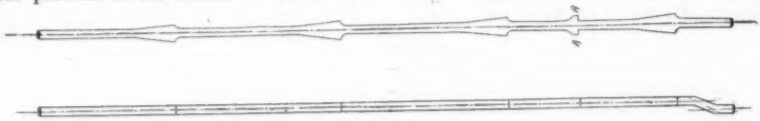


FIG. 16.

Another type of collapsible bar is used with toggle joints in the interior in place of the wedges, the toggles being worked

by means of a screw. This bar has to be fitted with a solid head and base which do not contract and often cause trouble, and another fault is the splashing of the metal into the inside when casting, which frequently sets on the toggles and prevents them working. In my opinion, the wedge bar is the most satisfactory that has yet been designed. In many foundries the solid bar is again superseding the collapsible bar, by using a composition covering, and dispensing with the straw rope.

The necessary patterns will be described in the next paper.

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SOME USES OF PRODUCER GAS.*

GAS firing has many advantages, for instance in many cases fuel can be used of the cheapest quality obtainable. There is practically no waste of fuel during standby. The gas can be conducted to any distance from the source of generation and the points at which it is used subdivided to any extent, without appreciable loss. The heat can be applied in a clean and direct manner to almost any industry where heat is required in considerable quantities.

We have made a number of tests of the time occupied and gas used for brass melting by producer gas, and below are tabulated some of the results:—

		Time melting.	Gas used.	Gas per cwt.	Fuel per cwt. of metal melted, say	
Metal.	Weight Lbs.	Min.	Cu.ft.	Ft.	Lbs.	Remarks.
Copper	14	45	210	1,680	21	Cold furn
,,	14	33	165	1,320	17	
Brass	31	60	272	890	11	
,,	50	104	9·0	2,200	28	,,
,,	50	90	850	1,920	24	

Malleable ironfounders' annealing ovens form one of the simplest installations of regenerative furnace work. Continuous regeneration is all that is required, the air and gas being heated by the exhaust gas passing alongside the flues provided for the incoming air.

I do not think that any regeneration whatever is required for the temperature necessary for annealing iron, and although it is no doubt economical in fuel to regenerate, it is doubtful whether the economy will repay the additional outlay and the much larger amount of repairs. Indeed in one of two instances brought before our notice benefit has been derived by giving up all regeneration and by using cold air and hot gas.

With any given draught or blast pressure, cold air mixed with hot gas will give a hotter flame temperature than hot air mixed with the gas. This is easily explained. The heated air is enlarged in bulk, and only a given bulk of air can be introduced in a given time, and consequently the amount of oxygen introduced is reduced, and a longer flame of lower temperature is obtained.

A system of regeneration which I have seen used, but which does not, I think, offer any advantages, is to heat the incoming air and gas by means of the heat of the combustion chamber itself. It appears to me that this is like robbing Peter to pay Paul, for the heat we introduce to the gases before firing them is simply taken out of the heat of the furnace; whereas the heat for this purpose should, of course, be derived from the waste gases after they have done their work in heating the furnace.

The advantages of this system over the ordinary coal-fired ovens are:—(1) Common slack can be readily used instead of coal; (2) the heat is got up much more quickly, and so time is saved; (3) only sufficient oxygen for combustion is admitted, and there is therefore considerable saving in fuel, and very considerable economy in the cost of annealing pots, which do not oxidise to anything like the same extent; (4) any gas-fired oven of given inside area will accommodate at least 25 per cent. more pots than a coal-fired oven, owing to there being no necessity to leave space for the fire bars and fire. In one case in Walsall the ovens now contain double the number of pots they used to do when they were fired by coal; (5) the temperature throughout the muffle is much more even.

In using producer gas for any purpose it is quite possible to waste the fuel, either by getting unburnt coal out with the ashes, or by using too much or too little air, and it is often difficult to detect this waste without some technical knowledge. I therefore always advocate that a log be kept, showing the coal used, working hours, and so on. An example of these logs which we have in actual use is appended. Every month these log sheets must be analysed by someone who can understand what he wants to get from them.

* From a paper read by A. E. Edwards before the Birmingham Association of Mechanical Engineers.

Specimen of Weekly Log Sheets for Muffles for Annealing Castings.

Date.	Coal.	Ho'rs run.	No. of muffles fired.	Output from muffles in tons.	New pots.	Repairs, etc.
1						
2						
3						
4						
Total						

This list might be added to indefinitely. No doubt my log sheets can be vastly improved, but at any rate they are, I hope, a step in the right direction, and some such records should be adopted by everyone with a gas plant. I have found them exceedingly useful, and very interesting to work out and compare the working of one plant with another.

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PICKLING CASTINGS.

A WRITER in "Obermayer's Bulletin" says that from the machine-shop workmen's standpoint there is a decided difference between castings which have been pickled and those which have not. No establishment that has used thoroughly pickling castings will be likely to be satisfied without pickling. Tumbling is not a substitute for pickling, as it does little toward removing the scale, but tumbling before pickling is good, as it saves the pickle. Pickling without tumbling is better than tumbling without pickling, so far as the wear of the tools is concerned. The wear of tools and the time required for re-sharpening and re-setting is much greater when used on sandy and scaly castings than on those which have been thoroughly pickled. When this fact is thoroughly appreciated and the time saving effected by pickling is known, the cost of the process cuts a small figure.

There are two somewhat different processes employed for pickling castings. For one process a lead-lined wooden tank is provided, of size and shape determined by the size, shape, and quantity of castings to be handled. With a tank 6 ft. long, 3 ft. wide, and 2 ft. deep, a large quantity of castings can be pickled. This tank should preferably be sunk a foot or so in the ground, and from one of the long sides a light wooden platform, say 6 ft. wide and 12 ft. long, with raised strips on the edges, should extend back. The platform should have a pitch of two or three inches to the foot towards the tank.

The pickle should be made 1 part vitriol to 4 parts water. It is a common mistake to think that more vitriol will hurry matters and do the work more thoroughly, for the reverse is the case, as an excess of vitriol retards the action, and therefore, should be avoided. In preparing the pickle, the water is put in first and the vitriol is added gradually, during which process the water heats up. Fill the tank to within 6 or 4 in. of the top. The articles to be pickled, if of convenient size to handle, are simply dipped in the pickle, so that they are wet all over, and then laid on the platform to drain and dry. If the castings are too large or too heavy for dipping, they are laid on the platform, and the pickle is then poured over them with a dipper. They should be turned as much as necessary to wet them all over, and none of the castings should be left so that the pickle has a chance to settle in pockets or places that will not drain. The castings are then left for eight or twelve hours, when they will be covered with a white powdery substance. It is only necessary to dip the castings in boiling-hot water, or to pour the hot water over them, until they are thoroughly cleansed of the acid, and when they are dry the process is completed. A hot-water tank is, of course, provided, with a steam pipe for heating the water. This water should be renewed frequently so that the acid will be thoroughly removed. An additional refinement is to provide a hot potash or soda bath before the final rinsing in clean water.

To pickle by the second process, tanks are provided of sufficient capacity to submerge the castings for several hours; sometimes they may remain in the pickle over-night. When taken out they should be rinsed at once in an adjoining tank of clear water, or, better, in two tanks in succession. The pickle for this slow process should be much weaker than for the first process described, the proportion of vitriol to water being about as 1 to 10.

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MESSRS. J. W. JACKMAN & COMPANY, LIMITED, of London, Manchester, and Glasgow, have just removed their Manchester office to No. 347, Chester Road, Cornbrook, Manchester, where, in addition to their office, they have a large warehouse, in which they carry a stock of foundry plant, machinery, and requisites.

RECENT METHODS OF MACHINE MOULDING.*

By E. H. Mumford, Philadelphia, Pa.

It is because I feel that I can tell you of some new things and some new combinations of old things, which I think are to make the year 1906 one memorable in the history of machine moulding that I venture to address you again.

They are as follows :—

1. Rock Over Moulding.
2. Jolt Ramming.
3. Match Plate Moulding.
4. Multiple Moulding.

So far as I know, Rock Over and Multiple Moulding by machines are ten years old. Jolt Ramming is over twenty years old, and Match Plates are the oldest of things in machine moulding.

From the hinged flask to the first Rock Over Machine was but a step. Put the pattern on a Match Plate and hinge it from a point outside the flask area, with a counter-balance spring or weight to help handle the weight of plate and pattern, and a simple spring clamp to hold a bottom board on, and you have the earliest good seller in the Rock Over machines. Its shortcomings are its radial pattern draft, which causes the pattern to bite off sand walls near the hinge especially, and the considerable error introduced by landing the mould on a more or less uneven bottom board. Mistakes have been made by designers putting brains and money into accurate pattern draft mechanism on machines, and afterwards vitiating all their designs by obliging their gear to draw a pattern from a mould which has tilted over on an uneven bed. You may know without trying that any machine that places a mould from which it is to draw a pattern on its back on a bottom board of any description, and then draws the pattern, regardless of the new plane of the mould joint, will not be satisfactory on work involving any appreciable pattern drawing accuracy; and even on the simplest work, if an absolutely clean lift is wanted, this inherent error will prevent it.

A decided improvement in Rock Over Machines has been introduced by giving the hinge of the Rocking pattern support a rectilinear guide intended to be normal to the mould joint in its line of draft. This has been a most valuable innovation, but at present has in it the fundamental error I have referred to, of trying to get a fair lift from a mould lying on a bottom board, with a fixed pattern draft.

There are several easy ways of avoiding this difficulty, and one of these is already in use. I refer to taking the datum for the pattern draft from the joint of the flask. The half flask lies on its back on its bottom board, and the pattern is drawn by guides resting on the joint edges of the flask. This is the correct method, and deserving of success.

Jolt Ramming.

Jolt ramming is twenty years old. If you consider merely the bumping of a mould to ram or partly ram it Jolt Ramming is as ancient as moulding, for all bench moulders have had occasion always to pick up a flask and bump it upon the bench to settle sand in the pockets.

So it is not, in itself, a novelty, though some of the early patents upon it having now lapsed, its public use is only recently being advertised.

The canons of success in Jolt Ramming are :

A dead drop,
A firm, solid machine,
Centre of impact under centre of gravity of falling mass.
Impact always central.

Until recently, Jolt Ramming Machines which draw patterns as well as ram moulds have combined both functions in integral mechanisms, and have been capable of ramming in only one way. Now, machines may be had which separate ramming from pattern drawing so that the ramming and pattern drawing elements may, if desired, be separately and simultaneously used, and as a consequence, a variety of pattern drawing elements—or what are commonly called "Hand Ramming Machines"—may be used upon a single Jolt Ramming element.

Most of the work which it pays to Jolt Ram is so deep that, to draw patterns, stripping plates are required. To change stripping plate patterns on a machine requires considerable time. It is, therefore, often convenient to keep a set of stripping plate patterns which are frequently used, permanently fixed upon a pattern drawing machine. Moreover, there is no good reason for keeping an expensive Jolt Ramming Machine idle while men are changing patterns on a pattern drawing machine, which may just as well be separate from it. Further-

* Paper read before the American Foundrymen's Association.

more, a man may purchase a single Jolt Ramming Machine, and add to it a variety of sizes of pattern drawing machines, and even use several of them at the same time on a Jolt Ramming Machine of sufficient capacity.

Ordinarily speaking, the cylinder of a pneumatic Jolt Ramming Machine is only large enough to raise promptly the weight imposed upon it. There is, however, no reason why this cylinder should not also be large enough to press a mould and be subject to the control of an automatic valve for Jolt Ramming, and at the next operation, to an ordinary throttle valve for press-ramming.

To illustrate, take a grate bar. The pattern is all in the drag, and is of such a nature that Jolt Ramming is best, but the cope is "flat back," and must be rammed *upon the drag mould* and pattern, sand to sand.

This is something Jolt Ramming cannot do. The pattern in the drag will settle down in the sand away from the joint, so press-ramming is necessary. A machine is now built for this use.

Match Plate Moulding.

I know you will say that this fell so long ago from the tree that the chestnuts cannot even be found in the burr! But don't forget that many a chestnut has grown a new tree!

Match Plates date from the good old days when moulders actually did their own thinking, and studied out ways to save their employer's time. Theirs is an honoured name, yet so many troubles have been laid at the door of match plates either ill-adapted for, or misused in their work, that many a man quits listening when you say match plates to him, and begins to do the talking himself.

Probably the first successful use of Vibrators was in connection with single-sided match plates, and there have been many applications of the match plate since then to machine moulding.

The making of match plates with patterns cast in their surfaces by a process which constitutes the plate a fin of $\frac{1}{4}$ in. or more around the casting of the pattern is very old, though not even yet known to all foundrymen. In forming the edges of such a plate, any desired shape may be given to the casting. For instance, about six years ago aluminium match plates were cast with rabbetted edges to fit frames surrounding them, which carried the Vibrators and flask pins, and with that now, there is little, if any, excuse for continuing the use of patterns feebly attached to the gates which run the castings.

This leads me to comment upon the fact that the match plate is deservedly rapidly displacing gated patterns in these days of speed in machine moulding, for the gated pattern requires the sand match or odd side and separate ramming of cope and drag, which the match plate does away with.

Given a gate or spray or master patterns, and an aluminium match plate with edges fitted to go in a Vibrator Frame, may be prepared now in an incredibly short time by a new process which I am not permitted as yet to fully describe.

While speaking of match plates, if you will allow me, I will mention an arrangement which is not yet completed and working, for the simple reason of lack of time, but the working of which is so simple, though, I believe, so novel that I think you will pardon my speaking prophetically of its success.

It is simply a hinged match plate in a hinged flask. Hinged flasks are no novelty, and match plates would undoubtedly long ago have been used in hinged flasks, except for the disposition of the thickness of plate in closing, and the freezing of the hinge so as to get the match plate away. We give the flasks a double pin hinge and put the hinge of the match plate in one of them, so that the cope hinges on the plate until the pattern is drawn and then transfers its weight to its second hinge pin to free the plate. The plate is then hinged out of the drag and taken away, when its hinges are so arranged that the cope closes in perfect registration on the drag.

This method of moulding avoids all handling of loaded flasks, and reduces the "machine" to nothing but a match plate.

As a *hinged* match plate, however, it is limited to such patterns as will hinge out of both cope and drag, and is not for deep work.

Multiple Moulding.

If I presented no development of Multiple Moulding beyond what has been known to the trade for some ten years, there would be little excuse for saying anything about it, but almost as much has been done in the last five years as was done in the first five of the approximately ten years of Multiple Moulding.

The first Multiple Moulds were just ordinary two-part moulds, piled one on another, with a sprue hole cut through the

drag part into the cope part of the mould below.

Next came the thought of utilising the idle joint between a drag part and a cope part.

It at once became evident that, in order to make this kind of Multiple Moulds, it was necessary to ram both top and bottom faces of the Multiple element simultaneously. This meant that the drag patterns should be rammed down into a block of sand while the cope patterns were being rammed *up* into it. The impracticability of pressing a pattern down into a struck surface of sand had, long years before, been shown in the operation of a machine in Scotland in which a double-faced match plate was swung in edgewise between cope and drag flasks, the drag flask already filled with sand, the cope flask filled with sand dropped upon the pattern. In this machine, just as in Multiple Moulding, until recently, the greater depth of the pattern had to be in the cope, and for the same reason—the common difficulty of getting sand *up* around the pattern, against the universally downward tendency of all things.

In 1902 Mr. P. D. Beckwith, at Dowagiac, Michigan, made a great improvement in Multiple Moulding by providing for filling the drag pattern while inverted and then holding the sand up against the drag pattern while turning it back upon the sand already filling the flask upon the cope pattern.

Although doing this accomplished for the first time the ramming of deep drag patterns in multiple, yet the time occupied in handling the drag patterns separately was sufficient to very much reduce the otherwise rapid machine moulding. There remained, however, the large saving in floor space and in sand and flasks inherent in Multiple Moulding.

And now comes Rathbone, with his new principle of neutralising gravitation by causing the unrammed sand in the flask, with excess sand enough in the removable sand frame over the flask to allow for compression, to move *up* against and around the drag patterns fixed to the Ramming Block of the machine with velocity equal to what it would have had if it had fallen in upon them.

By this means, Rathbone sets the loose sand up around his pattern before ramming in an instant of time and just as effectively as though accomplished, as of old, upon an inverted pattern. In other words, he gets the drag mould practically instantaneously without the heretofore inevitable rolling over either before or after ramming.

As yet, the Rathbone process has been operated without time savers such as hopper-fed sand and automatically struck sand faces. But, notwithstanding this, sixty 14 in. by 16 in. or 13 in. by 18 in. by 4½ in. moulds an hour are easily made by one man who shovels his sand from the heap and stacks his finished moulds eight or nine high.

As a rule, the flasks used for Multiple Moulding must be about 15 per cent. deeper than the half flasks used in ordinary two part moulding. This is because each flask has half of the cope and half of the drag patterns in it, and must have sand enough in its depth to allow for this.

Work of about 2 in. total depth is usually piled nine moulds high in flasks 4½ in. deep. That is ten flasks—nine moulds—in a pile.

The saving in sand and flasks accomplished under these circumstances is :

$$.85\left\{\frac{18-10}{18}\right\}=37\%$$

The saving of floor space is :

$$\frac{9-1}{9}=88\%$$

Most foundrymen think that the castings at the bottom of a pile in Multiple Moulding must strain, owing to the ferrostatic head of, say, 45 in.

Two things should be considered before assuming this :

FIRST.—That never were moulds so perfectly clamped and weighted as those at the bottom of a stack of nine moulds. If sand rammed as a liquid, and the same ramming pressure laterally as vertically might be assumed, the liquid iron would find walls of sand all about it set up at a pressure of at least 40 lbs. per square inch and held against displacement as never before. This iron, standing in a liquid column 45 in. high, would exert a pressure less than 12 lbs. per square inch, so that, unless the walls of the moulds yielded to such a pressure, and they would not, there could, even then, be no straining. But, the second consideration is that the usual guarantee against strained castings is had by so reducing the section of the gate which leads the metal to the mould as to ensure its having set before the column of metal in the sprue has risen to a height sufficient to put an excessive head on the mould.

THE LOWMOOR IRON WORKS.

THE Manors of North Brierley and Wibsey originally comprised several hundred acres of low-lying moorland, and it was upon the lower portion of this moorland that the Lowmoor Iron Works and the village surrounding them were first established. The centenary of the Lowmoor Iron Works was celebrated in 1891, but the inception of this great industrial undertaking goes back to the year 1789, when the Manors of Royds Hall and Wibsey were purchased from the assignees of Squire Leedes, who, having lived beyond his means, had come to grief the previous year. The entire estate, with all its valuable rights and accessories, came into the possession of the firm of "Hird, Dawson & Hardy," and the proprietary therein is still held by representatives of the families so named.

It was well known that there was abundance of coal upon the estate which the Lowmoor Company had purchased, but the late owner had no conception of the fact that beneath his broad acres there was an almost inexhaustible supply of iron ore. It was left to the enterprising firm who had purchased the Manor to develop the estate, and utilise the mineral treasures to their full extent.

The original "Trevithick" or "Boulton & Watts" blowing engine, which supplied blast to some of the old furnaces at Lowmoor Iron Works, is still in existence, but not working. This is one of the oldest engines in England, and is unique in its quaintness and design. It was designed by Mr. Edward Smalley, the Company's then engineer, and made by Messrs. Emmets, of Birkenshaw, near Bradford, as shown by the inscription in front of the air cylinder. It is what is termed an atmospheric engine, having an open top steam cylinder 5 ft. inside diameter. The piston worked with a covering of water on the top, which assisted in maintaining the vacuum. The valves were worked by the original "hand-gear" motion, with wheel tappets on the air-pump rod. These could be adjusted to regulate the steam admission and cut-off, to suit the return stroke of the piston. All the necessary

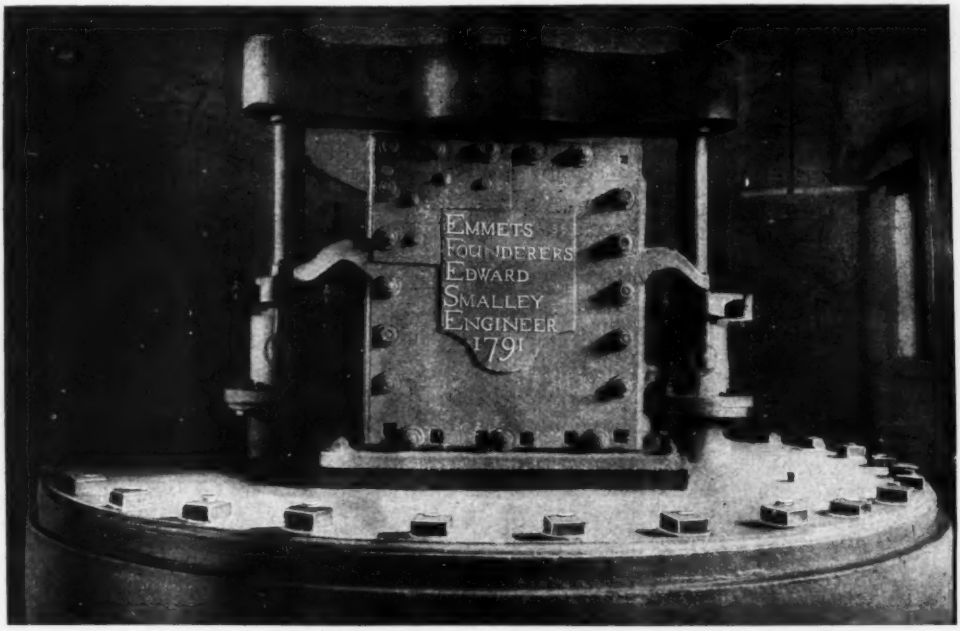

FIG. 1.—OLD BLOWING ENGINE AT LOWMOOR.

appliances—most of which are considered original—for condensing purposes, are still attached. The air cylinder, which is 8 ft. 5 in. inside diameter, is open at the bottom, there being four valves in the piston for admitting and discharging the air into the receiver, which was placed underground, and made of thick stone flags, carefully jointed and made air-tight with cement. This receiver was in use for many years, and served for two blowing engines and three blast furnaces. Ultimately, from the vibration caused by the large forge hammers adjoining, the cemented joints begun to leak, and the stone receiver was eventually abandoned, and a wrought iron one, placed above ground, substituted. There are two piston rods, placed 4 ft. 3 in. apart, working from a crosshead from which the

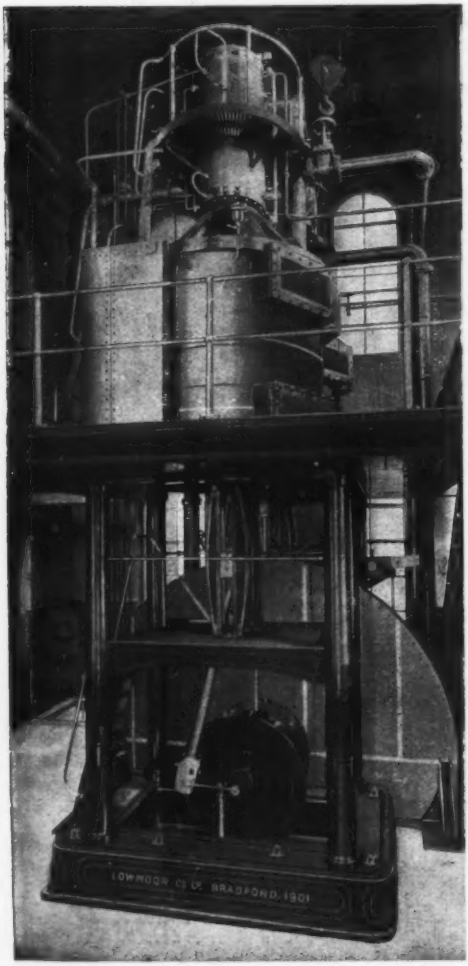

FIG. 2.—NEW BLOWING ENGINE AT LOWMOOR.

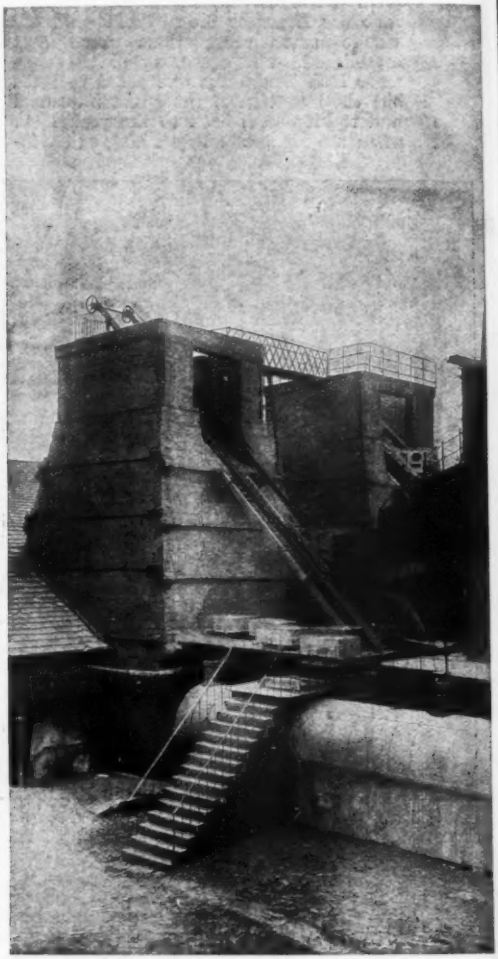

FIG. 3.—ORIGINAL BLAST FURNACE AT LOWMOOR, ERECTED IN 1791.

air piston is suspended. There are no wheels, cranks, or shafts in connection with the engine; all balancing arrangement is done by a metal weight bolted to one end of the engine beam. This allows means of adjustment to meet any variation in weight between the steam end of the beam and that of the air.

The new blowing engine was erected in place of one of the old ones, which was afterwards dismantled. It is a vertical high-pressure compound engine; high-pressure cylinder 17 in., low-pressure 28½ in., air cylinders 77 in.; 4 ft. stroke; worked with 100 lbs. steam pressure; air pressure about 2¼ lbs. The valves are so arranged that the engine can be worked high or low pressure, condensing, or compound condensing.

The engine is placed on a strong base-plate on the floor line, with a flywheel on crank shaft as shown in Figure 2. An upper metal frame fixed on pillars supports the steam and air cylinders, and keeps the whole of the parts perfectly rigid. It is well designed, and is capable of supplying the blast required for refineries, cupolas, and smiths' fires. The whole of the engine and attachments were made by the Lowmoor Company during 1901.

The work of excavating the foundations of the first blast furnace at Lowmoor Iron Works was commenced at Christmas, 1789, the foundation stone being laid in March, 1790. The exterior of the furnace was stone built of square form, and about 50 ft. high.

The original method of feeding the furnace was by hand labour. Baskets containing coke, ironstone, and limestone were carried or wheeled on a platform level with the furnace top, and the contents were dropped or thrown into the furnace. This system of feeding was abandoned in the year 1800, when the method of filling was changed to that of adopting a water wheel, driving a chain pulley, which hauled the carriages, enclosed in an iron frame and containing the ironstone, coke, etc., up an inclined plane (see Fig. 3). An automatic arrangement at the top tilted the carriage and emptied the contents into the furnace, and by disconnecting a clutch at the bottom, the empty carriage, by its own weight, resumed its position and descended to the loading floor.

During this period and long after, the calcining of the ironstone was done in stone-built kilns lined with fire-brick, and built in rows close to the furnace, with a tram road over the top bringing the stone direct from the colliery. After a while these kilns were not capable of producing sufficient ironstone to supply the furnaces, and large quantities were then calcined on the ground in the open air. Subsequently both these methods were abandoned, and "Gjer's" continuous kilns were erected close to the furnaces, and the same type are now in operation.

The Lowmoor furnaces having been in blast for over a century, the time had arrived when the Company considered it necessary to erect a new plant, and put into operation a blast furnace of larger dimensions. The new furnace has a bosh 18 ft. diameter, 8 ft. hearth, 15 ft. throat, and a height of 70 ft. This furnace commenced working in November, 1892. The kilns for calcining the Lowmoor ironstone are 40 ft. high, and 24 ft. diameter. A complete system of locomotive haulage is arranged for conveying the ironstone to the kilns. The new furnace is equal to a weekly production of about 340 tons of cold blast pig-iron. An additional furnace has been erected, closely adjoining the one above described, of rather less capacity, having a bosh 14 ft., hearth 7 ft., 11 ft. 6 in. throat, with a similar height to that of the larger furnace, viz., 70 ft., so as to utilise the same lift and landing stage. The output of this furnace is equal to about 240 tons per week, all cold blast pig-iron. The above being closed-top furnaces, the gases are conveyed through downtake tubes to the boilers, and generate sufficient steam for supplying blowing engines, coal washer engine, and also the engine for driving the electrical generator. These two furnaces are erected on the same site as two smaller open-top furnaces which were erected during 1836, each of which had a weekly output of about 70 to 80 tons. The blast furnaces are situated about half a mile from the general works, and the pig-iron is hauled by locomotives to the refineries.

The commencement of the foundry at Lowmoor Iron Works would be contemporary with that of the blast furnace, viz., at the latter part of the year 1791. During the first few years the output consisted chiefly of miscellaneous articles, such as coal wagon wheels, cast iron rails, pillars, and other hardware for building purposes; but within a comparatively short time the Lowmoor Company began the manufacture of guns for artillery purposes. It is recorded that guns were made at Lowmoor Iron Works during 1795, and doubtless cast iron shot were also made at that time, as these formed

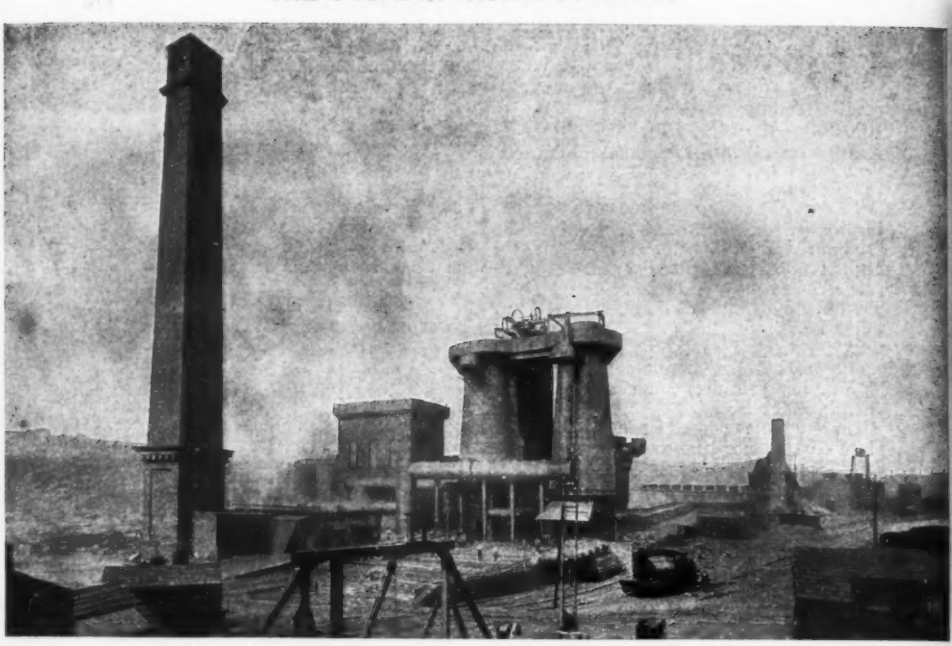

FIG. 4.—NEW BLAST FURNACES AT LOWMOOR, ERECTED IN 1892.

FIG. 5.—OLD FOUNDRY AT LOWMOOR. ERECTED ABOUT THE YEAR 1791.

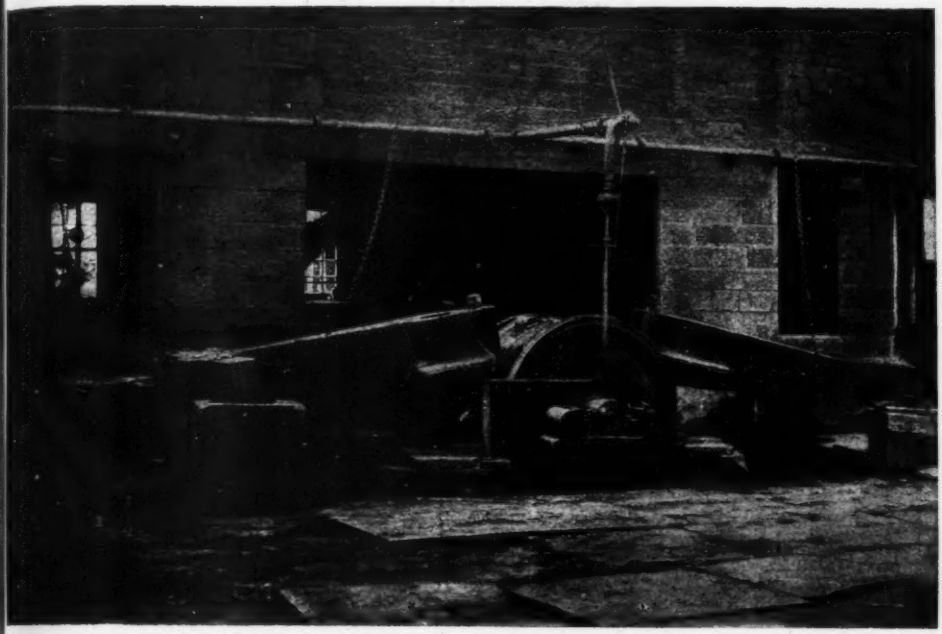

FIG. 6.—ORIGINAL TILT HAMMER AT LOWMOOR.

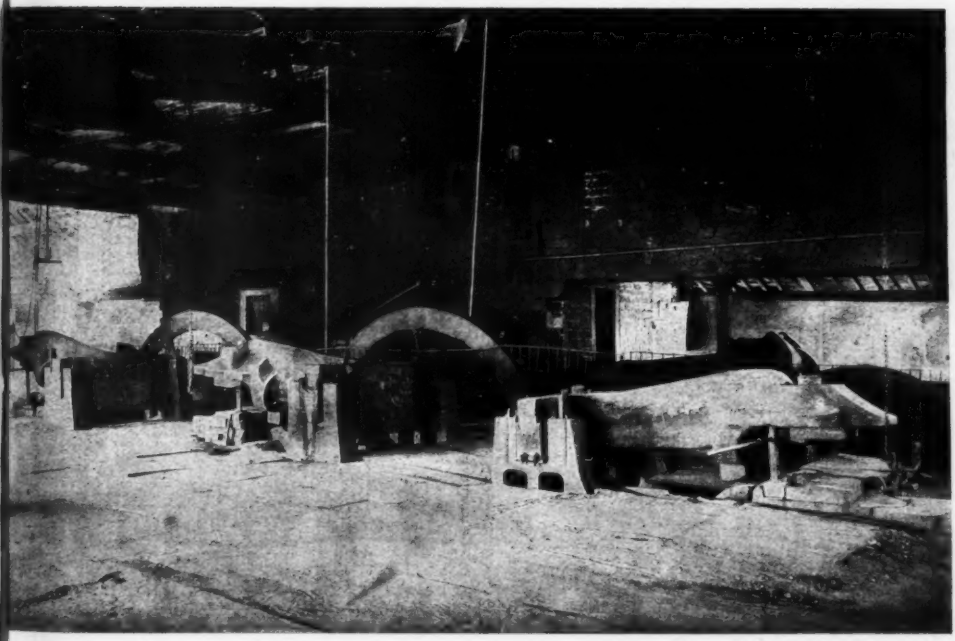

FIG. 7.—SLAB FORGE HELVES AT LOWMOOR, DISMANTLED IN 1904.

part of the same branch of trade. This business the Company energetically carried on for many years, for in 1854 the weekly output of shot, shells, guns, and mortars amounted to several hundred tons.

The foundry during these years was also occupied in making castings for the colliery and engines, such as beams, cylinders, bed-plates, etc., and also castings for forge purposes, many large castings being required for the latter purpose, especially when various extensions were made in the forge.

Another branch of trade which the Company was extensively engaged in was the making of sugar mills of various sizes, some being heavy machines requiring fairly heavy castings. This class of work was carried on at Lowmoor Iron Works for many years.

The first record in connection with the forge is found during the year 1801. There would be no puddling furnaces at Lowmoor at that time. Charcoal fires were used, with a slitting mill attached, for producing nail rods, and very small flat and square bars.

During 1802, forge hammers were erected, a view of the original one being shown in Figure 6. This hammer, or rather two hammers combined, was driven by a low-pressure reversing condensing engine.

The reversing arrangement was by means of revolving tappets bolted to the air-pump rod which regulated the valves. The hammers—one on each side of the cam shaft—could, by reversing the engine, be worked alternately. One was generally used for making rough blooms; the other used for forgings, shafting, etc.

The first reference to puddling at Lowmoor Iron Works is recorded in a written agreement dated May 11, 1803, in which John Davis agrees to serve the Lowmoor Company as puddler for the term of three years, upon certain conditions, viz., prices per ton, house rent and coal free, and expenses of family's removal allowed. Only a small number of puddling furnaces were built during the first few years, the number being increased as demand required. The method of puddling as now carried on at Lowmoor Iron Works differs only slightly with that of former years.

The year 1843, and probably a little before that, was the period when steam hammers were being introduced, and Mr. Nasmyth, of Patricroft, the inventor, was very wishful for the Lowmoor Company to adopt them, he being very sanguine that eventually (as has since been proved), this class of hammer would supersede all others previously used.

The Company, however—not yet being convinced as to their general utility for forge work—were deciding in 1843 and 1844 to put down several additional hammers of quite another design. These were named "Helves," as a distinction from the old tilt hammers, and were driven by a 30 h.p. low-pressure engine, with very powerful gearing attached. They were suspended at one end, and lifted near the centre by a three-armed revolving cam, keyed on the driving shaft. A view of one of the forges where three hammers of this class were situated is shown in Fig. 7.

These hammers were considered quite up-to-date, and did good service especially for blooms, slabs, and other plain work. They had been tried for making locomotive cranks, but were not a success; still they were used for other purposes until 1904, when seven of them were dismantled, and steam hammers substituted.

During 1844, however, Mr. Nasmyth prevailed upon the Company to try (almost as an experiment) a 4-ton steam hammer, this being the largest attempted to be made up to that date. The hammer was erected and for a time was worked under great difficulties, partly owing to complication in valve and motion arrangement, and partly to the forgemen's prejudices. It is recorded, too, that those who had the supervision of the hammer were not satisfied with its working, and informed the maker that he had erred on the heavy side, and that a 2½-ton instead of a 4-ton hammer would have been more suitable for general purposes. In the course of years it was proved otherwise, and in 1864 a steam hammer double the weight, viz., 8 tons, was erected for a heavier class of work. The difficulties in connection with the original steam hammer, however, were eventually overcome, and the hammer became most useful in making fairly heavy and difficult forgings. All the piston rods, connecting rods, crank pins, and several other forgings for the "Great Eastern" steamship, were made under this hammer. The hammer was worked continuously until 1864, when it was found that, owing to its single action (working by gravitation), it was too light for the work required. It is still in existence, however, and is frequently at work.

Lack of space prevents us describing the rolling mills and rivet and chain plant.

The testing house contains one of Messrs. Buckton's 50-ton single lever testing machines. The lever is graduated to indicate tons, tenths and hundredths of tons, and is fitted with knife-edged fulcrums at 3 in. centres, to work up to 50 tons. The machine is made with a hydraulic straining cylinder 10§ in. diameter and 6 in. stroke, and fitted with hydraulic valves for admitting and exhausting water from the accumulator, which works at 1,500 lbs. pressure, with a 4 in. ram and 4 ft. stroke.

"Lowmoor" iron has attained its high reputation by commencing the manufacture with an uniform and well-known raw material. Engineering in several branches has been carried on at Lowmoor Iron Works for many years, originally for making cast and wrought iron shafting, general millwrights' work, and afterwards stationary engines, of which many are still turned out. The Lowmoor Company have also gone into machine tool making, such as turning lathes, planing, boring, and drilling machines in great variety.

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FLUXES IN THE CUPOLA.*

THE value of fluxes in the cupola is not generally appreciated by foundrymen. Hundreds of cupolas are not slagged at all, and the cinder dumps show an immense amount of iron actually wasted. Not only is iron lost by the large amount combined with the cinder, but the more or less infusible cinder encloses small masses and shots of iron which cannot be separated. It is a fact that the cinder dumps of many foundries contain more iron than many workable deposits of iron ore.

Another value of fluxes is their cleansing action on the cupola. A well-slagged cupola has no hanging masses of iron and cinder which require laborious chipping out. The time and labour saved in consequence is an item that is well worth considering. In the running of heavy tonnages from a single cupola fluxes are indispensable. It would be well-nigh impossible to run large heats in the same cupolas without using a good flux.

The value of fluxes being generally admitted, the question arises, what flux is best to use, and how much? There are two available fluxes for the cupola; these are limestone and fluorspar. Fluorspar is much advertised as a flux, and the promoters claim that it gives marvellous properties to the iron. The practical tests of fluorspar made by the writer showed it to be an inferior flux; it did not remove sulphur, and the properties of the iron were not improved in the least by its use. There is no doubt of the value of fluorspar in certain branches of metallurgy, but the writer has failed to find a single supporter of its value in the foundry.

Limestone is far cheaper than fluorspar and far better as a flux. It makes little difference what form the limestone has so long as it is pure. It may be marble, soft limestone, hard limestone, oyster shells, or mussel shells, but it must be good. A limestone containing over 3 per cent. of silica is poor stuff, and one containing any considerable amount of clay should be rejected. There should be at least 51 per cent. of lime present. The sulphur should be below 1 per cent. to 2 per cent. The phosphorus is not important. A magnesian limestone would do as well as ordinary limestone for the cupola. The amount of limestone to be used is variable, depending first on the amount of silica in the coke ash. Second, on the amount of silica or sand adhering to the pig or scrap. And, third, on the amount of silica to be carried by the slag.

The amount of limestone required to flux the coke ash can be figured according to the ordinary method of calculating blast furnace charges. The amount of sand on the pig and scrap is so variable that it is difficult to know just the additional amount of limestone to add.

The most practical slag and easily fusible slag has been found to be a monosilicate, which means having equal amounts of silica and alkaline bases. Having these three variables in mind we find it a good rule to figure the limestone on the weight of the coke, using 25 per cent. limestone. For example, if the charge of coke on the bed is 4,000 lbs., we use 1,000 lbs. of limestone. If the next charge of coke is 1,000 lbs., we would use 250 lbs. of limestone. This amount of limestone will flux any ordinary coke ash with the average amount of sand on pig and scrap. If we know the amount of sand on the pig to be excessive we figure 30 per cent. limestone on the weight of the coke. With a low coke ash, machine pig, and clean scrap, the limestone may be reduced to 20 per cent. and make a good cinder.

Many foundrymen are afraid to use limestone, fearing some injury to the

* Paper read before the American Foundrymen's Association by Mr. N. W. Shed.

iron. This is a superstition, for the lime has no effect on the iron. There is usually a slight reduction in the amount of sulphur, but owing to the great amount of iron present, the iron absorbs a large amount of sulphur from the coke. If more than 30 per cent. is required to make a good cinder and clear the cupola, it is evident that either the coke is very high in ash, or else the limestone is high in silica. In the latter case, a large amount of lime is used in fluxing its own silica.

On account of the frequent variations in the stock it is a good plan to have coke, limestone, and cinder analysed occasionally. The cinder usually tells about the condition of the furnace. A light brown indicates a small amount of iron and the iron unoxidised. A black cinder usually indicates a large amount of iron, and some oxidation. A shiny metallic lustre shows an excess of oxide of iron due to over-blowing or lack of coke. Practically all the lime cinders from a cupola are glossy in appearance, while the cinders with no lime are usually dull and earthy.

Occasionally, a cinder is found full of bubbles, the colour is usually black, and shots of iron are found through the frothy slag. This is called foaming cinder, and is made when the last few charges are at the bottom of the cupola. This cinder often rises to the charging door and flows out over the floor. The iron cast at this time is hard, and low in manganese, silicon, and carbon. With the foaming slag a dense smoke of reddish-brown colour pours out of the stack. Analysis of this foaming slag shows the iron to be in an oxidised condition, and in large amount. Sometimes the iron will run to 30 per cent. in a frothy cinder, sometimes only to 12 per cent. The oxidised cinder and the red smoke show that iron is being rapidly burned in the cupola, and the action going on is very much like the action in a Bessemer converter when it is tilted a little and blown to gain heat by burning the iron. The cinder is oxidised, and the red smoke produced in the same way. In both cases the iron is burnt to oxide, which is quickly taken by the slag. The oxygen in the slag acts upon the carbon of the iron, forming a large amount of carbonic oxide, which rises through the cinder, blowing it to a frothy condition. There are two ways of avoiding this troublesome condition. If possible, reduce the blast. If blast cannot be reduced, add more coke. The presence of a good body of coke will stop the burning of the iron, and the frothing does not take place.

In some cases the loss of silicon is very serious, and to insure good castings it is necessary to add crushed ferro-silicon and ferro-manganese to the stream of iron as it runs from the spout. Analysis of cupola slags where no flux is used show from 14 per cent. to 28 per cent. These slags contain 2 per cent. to 4 per cent. of shot iron mingled with the cinder. This proves that some of the iron must be lost in order to flux the coke ash and sand. If we need limestone as a flux the amount of iron in the cinder is rarely over 3 per cent., showing that the lime fluxes the ash and sand, leaving the iron for the ladle. And the question is simply whether we will use iron as a flux, or limestone. Another point in favour of the limestone is the clean cupola.

The following is an analysis of cupola cinder using lime, compared with an analysis of cinder without lime:—

	Using lime.		Without lime.
CaO ...	34.60	CaO ...	6.40
FeO ...	4.10	FeO ...	21.76
Al_2O_3 ...	11.32	Al_2O_3 ...	11.80
SiO_2 ...	48.20	SiO_2 ...	58.44
MnO ...	1.40	MnO ...	1.30
S ...	.20	S ...	.10
	99.52		100.00

—o—

THE PIFTIN SYSTEM FOR DRYING SAND AND LOAM MOULDS IN THE FLOOR.

At first sight it would appear almost impossible in drying sand and loam moulds in the floor that 90 tons of fuel may be saved out of every 100 tons now burnt, and, nevertheless, result in better work.

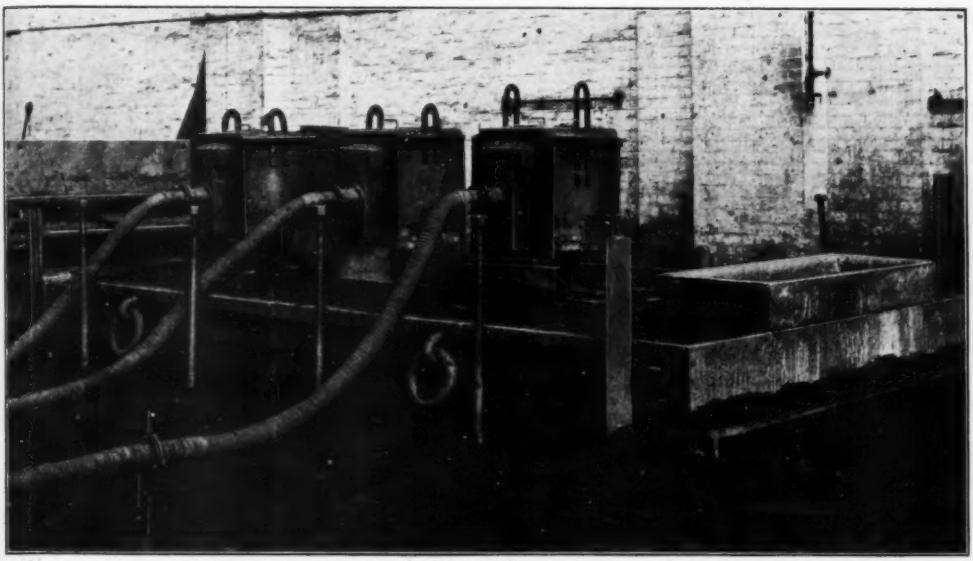
To take an ordinary example—the mould for an engine-bed weighing from 5 to 6 tons, which would take in the ordinary way about twelve 75-lb. kettles of coke (say, 900 lbs.) and require about eight hours to dry. These moulds are now dried regularly by the system under description in under a couple of hours, bone dry, with less than 70 lbs. gas coke. The top and bottom parts are dried together; so that one may say the top part costs nothing to dry, and stove room is saved. The saving in time and fuel is equal, whether for just skin-drying a light sand mould or for drying and baking hard a heavy loam mould. A few minutes suffice to skin-dry a mould.

The system is as follows:—Air (cold) is taken from the fan in light pipes along the foundry walls or pillars, and flexible pipes take the air from this main to wherever

the mould may be. The flexible pipes are connected to the inlet of the Piftin stove, the outlet of which passes the air (hot) into the mould. The stove is a perfect enclosure except for the 4-in. inlet and outlet.

A hole about 4 in. diameter is left in the top box for the hot air to pass in, the connection between the Piftin stove and the mould being made tight with loam, and the top box or plain part is placed on the drag (or lower part), or within an inch or so above it, the space between being filled up with sand or what not, except here and there for the air to pass out when charged with moisture. The stove takes about 25 lbs. coke to a charge, and when started may be left for an hour, the flexible pipe from the coal air main being fixed to the inlet of the stove. For moulds of an exceptionally large area, two stoves may be used with advantage. In many cases some of the cores may be dried in the mould. For an open sand mould, an iron sheet may be placed on it to form the enclosure, with a hole in it for the hot air to pass in. The expedition of the work is such that even the largest moulds may be dried and cast the same day, thus often saving a day in the foundry.

The heat obtained may be sufficient to bring to a red heat, as may be required for steel moulds, ladle-linings, and such like, but for ordinary work in an iron foundry the heat is regulated to about 450 to 500 degrees Fahr., and each stove will heat about 10,000 cubic feet of air to this degree for an expenditure of about 25 lbs. of coke. It will readily be seen that such a volume of hot air passing into and through the mould will quickly dry it. The air pressure being only about half an ounce per square inch, this throws but little work on the fan, and quite a small fan will supply the necessary volume of air for several stoves. The stove measures about 2 ft. each way, and is lined with fire bricks. Moulds of any area, any depth, or any shape, even the most intricate, are quite easily dried. It will be obvious that with this system the use of open coke kettles in the foundry is done away with, consequently there are no fumes, and a cooler foundry results. This stove is also adapted for use in connection with compressed air, so that in foundries where compressed air has already been installed, the use of a special system of piping, etc., is avoided, the requisite cold air blast being supplied direct from the compressed air pipes through special jet to the stoves. The stove is made by Messrs. Piftin, Limited, of 143 to 147, Rosebery Avenue, London, E.C.



GROUP OF THREE PIFTIN DRYING STOVES AT THE WORKS OF MESSRS. WILLANS & ROBINSON, RUGBY

TRADE TALK.

T. W. Lawley, Limited, engineers, etc., have removed to Plant's Green Iron Works.

Messrs. Webster & Bennett, of West Orchard, have established a new foundry at Foleshill, Coventry.

Messrs. Bailey & Clapham, engineers, have removed to the Acetylene Works, Alice Street, Keighley.

Messrs. Brown & Ward, engineers, are removing to Branston Works, Branston Street, Birmingham.

Mr. H. M. Sayers, M.I.E.E. has removed his business to 39, Victoria Street, Westminster, London, S.W.

The Royal Engineering College at Cooper's Hill has now been closed after an existence of 33 or 34 years.

An explosion took place at the Globe Foundry, East Moors, Cardiff, recently, but the damage was not serious.

Adamson, Ramsbottom & Company, Limited, Cleveland Works, Birkenhead, have started business as engineers.

George Clark, Limited, the well-known Wear marine engineers, are about to extend their works at Southwick.

A manufacturers' and industrial exhibition will be held in the Drill Hall, Bristol, from September 24 to October 20 next.

Messrs. J. Hoyle and H. Leech, engineers, etc., Shaw, trading under the style of Hoyle & Leach, have dissolved partnership.

Messrs. Princeps & Company, Sheffield, have been appointed sole manufacturers and licencees of the R. & H. patent packing rings.

The plant and machinery at the Britannia Foundry, Burnham, Bucks, were offered for sale by public auction on Thursday, August 30.

The Staveley Coal and Iron Company, Limited, have an order to supply the Horwich Urban District Council with 3-in. cast-iron pipes and specials.

The Forward Foundry, Kate's Hill, Dudley, together with the plant and machinery, will be offered for sale by public auction on September 10.

Messrs. T. M. Anderson and R. Wormald, engineers, etc., Oldham, Lancashire, trading under the style of Taylor & Company, have dissolved partnership.

The development of the new premises at Scotstoun of Messrs. Yarrow & Company, is proceeding rapidly, the structural work of the shops being well in hand.

Macdonald, Adamson, Swinburne & Company, Limited, engineers, 256, Argyle Street, Glasgow, have acquired the works of the Standard Iron Company, Barrhead.

The discharge from bankruptcy of Mr. D. Hatch (trading as Marshall & Hatch), Bingfield Street, King's Cross, N., iron-founder, has been suspended for two years.

John Elsworth & Sons, Limited, 39, Robertson Street, Glasgow, have acquired the engineering business of Messrs. Wassell & Murdoch, of 25, Centre Street, Glasgow.

Mr. H. Vickers, foundry manager, of Elland, was recently awarded £160 damages and costs for breach of contract against James Lumb & Sons, engineers, of Elland.

The Stanton Iron Works Company, Limited, are supplying 42-in. and other cast-iron pipes and castings to the Metropolitan Water Board to the amount of £23,531 16s. 6d.

The North-Eastern Railway Company have arranged for the construction at their Gateshead Works of no fewer than 30 powerful four-wheeled coupled bogie express locomotives.

Mr. G. R. Peers has entered into partnership with Messrs. Copeland & Cardin, of Newport, Mon., and the firm will in future trade as Messrs. Peers, Copeland & Cardin.

Messrs. A. C. Potter & Company (A. C. Potter, F. Baker, and R. W. Bennett), engineers, 54, Lant Street, Southwark, have dissolved partnership so far as regards Mr. F. Baker.

A company has been formed at Milan, Italy, for the manufacture of Mannesmann tubes in that country. The company will be known as the Societa Anonima Tubi Mannesmann.

The engineering works in Pepper Road, Hunslet, Leeds, lately in the occupation of Graham, Morton, Limited, have been sold by auction, the purchaser being Mr. J. Henry, of Leeds, for £13,500.

It is stated that Messrs. Lysaght & Company, Osier Bed Iron Works, Wolverhampton, are negotiating for land on the Elwes estate, in North Lincolnshire, for the purpose of erecting new works.

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MANCHESTER.

Telegrams—"Ladles," Manchester.
"Blackings," Glasgow.

Telephone—2297 National, Manchester.
3155 Bridgeton, Glasgow.

PERSONAL.

THE late Mr. G. J. Snelus left estate of the gross value of £17,842.

MR. J. M. LAIRD has resigned his seat on the Mersey Docks and Harbour Board.

SIR WILLIAM ARROL has been very seriously ill of late, and successfully underwent an operation.

MR. N. G. FERGUSSON has resigned his directorship of H. Borner & Company, Limited, of 14, St. Mary Axe, E.C.

MR. S. BALDWIN has been elected a director of the Gloucester Railway Carriage and Wagon Company, Limited.

MR. RICHARD HILL, chairman of Richard Hill & Company, Limited, of Middlesbrough, is at present indisposed.

THE late Mr. J. Jarvis, of Messrs. W. Jarvis & Sons, ironfounders, York, left estate valued at £4,919 gross and £2,600 net.

MR. W. E. ADIE has been elected a director of Samuel Fox & Company, Limited, Stocksbridge Iron Works, Sheffield.

THE late Mr. J. Bates, of Cheadle Hulme, Cheshire, retired foundry manager, left estate of the gross value of £6,384.

MR. T. RICHARDSON and MR. M. FURNESS have been elected directors of Richardsons, Westgarth & Company, Limited.

MR. C. D. HOLMES, of Messrs. Holmes & Company, engineers and boilermakers, Hull, has been made a J.P. for that borough.

MR. H. T. WIGHAM has been appointed manager of the London office of the United States Steel Products Export Company.

THE late Mr. A. Coote, a director of Messrs. R. & W. Hawthorne, Leslie & Company, Limited, left estate of the gross value of £93,438.

THE gross value of the estate of the late Mr. G. M. Marchant, of the Rashcliffe Brass and Iron Works, Huddersfield, is £9,411.

THE late Mr. R. Hollingdrake, head of the firm of Messrs. Hollingdrake & Son, ironfounders, Stockport, left estate valued at £41,321 gross.

MR. W. DYSON, of Messrs. Owen & Dyson, Rother Iron Works, Ickles, Rotherham, has been made a J.P. for the West Riding of Yorkshire.

SIR J. E. JOHNSON-FERGUSSON has been elected chairman of Bolckow, Vaughan & Company, Limited, in place of Mr. E. Windsor Richards, resigned.

MR. W. BYNG KENRICK, managing director of Archibald Kenrick & Sons, Limited, ironfounders, West Bromwich, was married during the month.

MR. W. D. CLIFF, chairman of the Leeds Forge Company, Limited, has decided to retire. Mr. H. E. Cliff has also resigned his seat on the Board.

THE estate left by the late Sir Thomas Richardson, vice-chairman of Richardsons, Westgarth & Company, Limited, entered for probate at £138,507.

MR. J. G. DUNLOP, acting director at the Clydebank shipbuilding and engineering works of John Brown & Company, Limited, has been appointed managing director of the company conjointly with Mr. Charles Ellis.

THE late Mr. C. H. Crane, formerly head of the business now carried on by the Crane Ironfoundry Company, Limited, and a director of the Wellingborough Iron Company, Limited, left estate amounting to over £138,221.

Ganister, Cupola Blocks, Fire Bricks,
Fire Clay.
Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.
Steel Moulders' Composition, Silica Cement.

J. GRAYSON LOWOOD & Co., Ltd.,
DEEPCAR, nr. SHEFFIELD.
Telegrams: "LOWOOD, DEEPCAR."

"GLYCO" METAL Co., LTD.,

MANCHESTER.

WE GUARANTEE "GLYCO"

AS A BEARING LINER

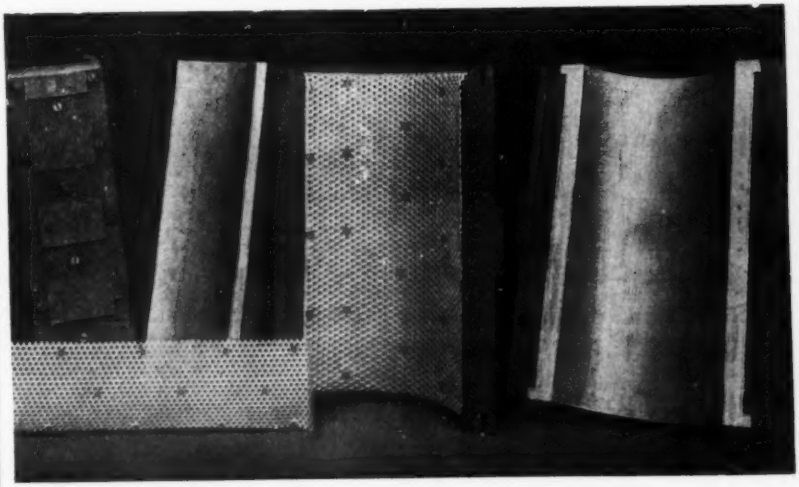
EQUAL IN EFFICIENCY

TO THE HIGHEST PRICED TIN ALLOYS

AT LESS THAN HALF THEIR COST.

PATENT GLYCO-EMBEDDED SKELETON BEARINGS.

The Illustration shows a Crank-Shaft Bearing, consisting of Steel Shell with Bronze or Steel Skeleton embedded in "Glyco."



Increased Strength, Higher Efficiency, Low First Cost, Large Saving in Lubrication, and Nominal Cost of Re-lining.

LIBERAL TERMS TO THE TRADE.

DEATHS.

MR. J. MATHIESON, ex-general manager of the Midland Railway Company.

MR. H. H. WEST, of Birkenhead, well known as a consulting engineer and naval architect.

MR. W. H. PROTHEROE, for many years manager of Elliott's Smelting Works, Swansea.

MR. W. G. REYNOLDS, one of the best known marine engineers on Newcastle Quayside.

MR. A. SHANKS, who was a partner of the now defunct shipbuilding firm of Messrs. Napier, Shanks & Bell, Yoker.

MR. J. A. RILEY, managing director of J. A. Riley & Company, Limited, Canal Boiler Works, Huddersfield, at the age of 54 years.

MR. J. M. CHAPMAN, recently in business as an ironfounder, etc., at the Victoria Iron Foundry, Moses Gate, Doncaster, aged 69 years.

MR. W. BILLINGSLEY, for many years manager of the business of F. W. Cotterill, Limited, nut and bolt manufacturers, Darlaston, at the age of 80 years.

MR. T. THOMPSON, at one time connected with the firm of Messrs. G. C. & A. Thompson, Winlaton, and Messrs. Thompson Brothers, forge manufacturers, Dunston, in his 76th year.

MR. ERNEST FARNWORTH, who was widely known in connection with the iron trade of South Staffordshire, having managed a section of the Corrugated Iron Works, Wolverhampton, which are perhaps better known as the Shrubbery Sheet Iron and Steel Company.

—o—

THE GREAT CENTRAL RAILWAY COMPANY, who have lately put in hand at their Gorton Works six six-wheel coupled outside cylinder shunting locomotives, have also placed contracts for 25 additional locomotives. Kitson & Company, Limited, of Leeds, will build 13 eight-wheel coupled mineral tender engines; and Beyer, Peacock & Company, Limited, of Gorton Foundry, Manchester, 12 four-wheel coupled passenger tank engines.

ELDERS FOUNDRY COKE

As supplied to the British . . Admiralty Dockyards.

The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.
We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blow-holes and other defects, than we formerly did.

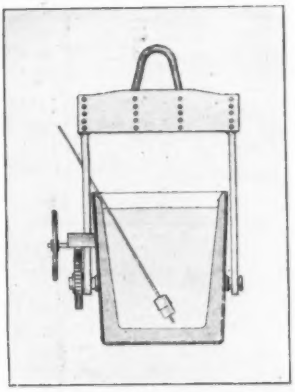
From MOUNTFORT PHILLIPS & Co., Llantrissant.

Llantrissant, October 25th, 1904.

In reference to the Foundry Coke you have been supplying us with for the last six months, we have very great pleasure in letting you know that it has given every satisfaction, and that our Works Manager and Workmen give it the highest praise.

Elders Navigation Collieries, LTD. Cardiff.

PREVENTION OF BLOWHOLES IN CAST IRON.



A tin of our special compound fixed on a rod is held at bottom of ladle as shown; a strong re-action being thereby set up frees the iron from gases and impurities, which rise to the top.

RESULT: A denser casting of finer grain with increased strength.

For Particulars apply to—

THERMIT LIMITED,

27, MARTIN'S LANE, CANNON STREET,

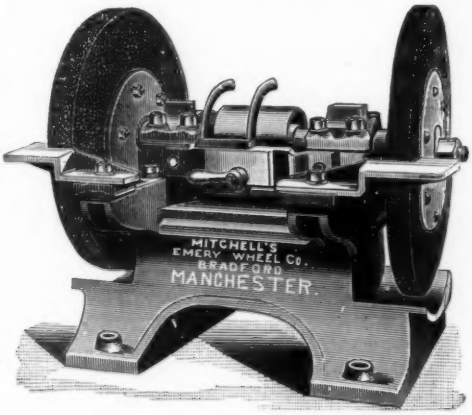
Telephone—3749 Central.
Telegrams—"Fulmen," London.

LONDON, E.C.

MACHINES For all Purposes. **WHEELS.**

Complete with Emery or Corundum Wheels from **£2** upwards.

Special Machines Designed.



Emery or Corundum from 1 in. x $\frac{1}{8}$ in. to 50 in. x 12 in.

Enquiries solicited.

MITCHELL'S EMERY WHEEL Co.,

Mill Street, Bradford, MANCHESTER.

Also at LONDON, GLASGOW, and BELFAST. LISTS FREE.

PRICES OF METALS.

The following table shows the approximate latest prices and position of stocks of metals during the past two years :—

METALS.	1905-6.	1904-5.
Iron—Scotch pig warrants ... ton	59 0	—
—Middlesbro' warrants ... ... ton	54/0	48/1
—W.C. M/nos Bessemer ... ... ton	68/0	58/6
—Stock, Scotch, Aug. 30 ...tons	11,234	17,038
Copper—Chili bars, GMB ... ... ton	£81 17 6	£70 15/0
—Stock, Europe & afloat... ... tons	12,355	18,0.3
Tin—English ingots ton	£184 10/0	£151 10/0
—Straits ... ton	£182 10/0	£151 17/6
—Stock, Ldn. Hlnd and aflt ... tons	12,295	13,531
Lead—English pig ton	£17 15/0	£14 15/0
Spelter—Ord. Silesian ... ... ton	£27 5/0	£25 12/6
Quicksilver-(75lb.) bottle	£7 0/0	£7 2/6
Antimony—Regulus ... ... ton	£104 0/0	£62 0/0

*Settlement price.

CASTINGS.

In the Cleveland district the following are the nominal rates current for castings :—

	£ s. d.		£ s. d.
Columns (plain)	6 15 0	to	7 5 0
Pipes, 1½ to 2½ in.	5 2 6	to	5 7 6
,, 3 to 4 in....	4 15 0	to	4 17 6
,, 5 to 8 in.	4 12 6	to	4 15 0
,, 10 to 16 in....	4 12 6	to	4 15 0
,, 18 to 24 in....	4 12 6	to	4 15 0
Chairs	3 15 0	to	3 17 6
Floor plates (open sand)	3 5 0	to	3 7 6

SCRAP.

The quotations for scrap, subject to market fluctuations, are as follows: — Heavy wrought (mixed), £2 13s. 6d.; light wrought, £1 6s.; heavy cast, £2 6s.; all per ton f.o.b., London. Copper (clean), £78; brass (clean), £53 10s; lead (usual draft), £16 10s.; tea lead, £14 15s.; zinc, £22 5s.; all per ton delivered merchant's yard.

SILICA FIRE BRICK Co.,

OUGHTIBRIDGE.

GROUND GANISTER,

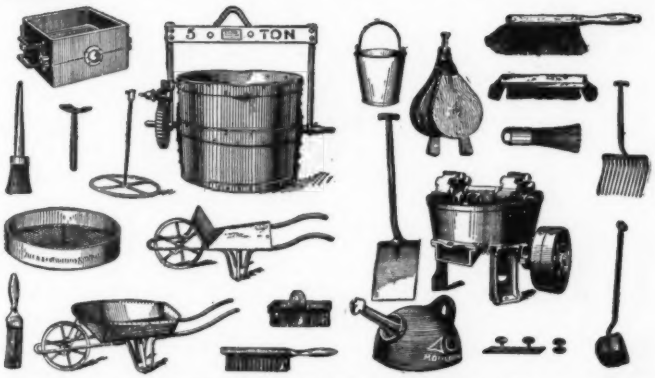
Wet or Dry.

Silco Cupola Bricks, 90 % Silica.

Better than Fire-clay Bricks for Cupolas.

Established 1863.

Jas. Durrans & Sons,



PHŒNIX WORKS, PENISTONE, Near Sheffield.

Manufacturers of all

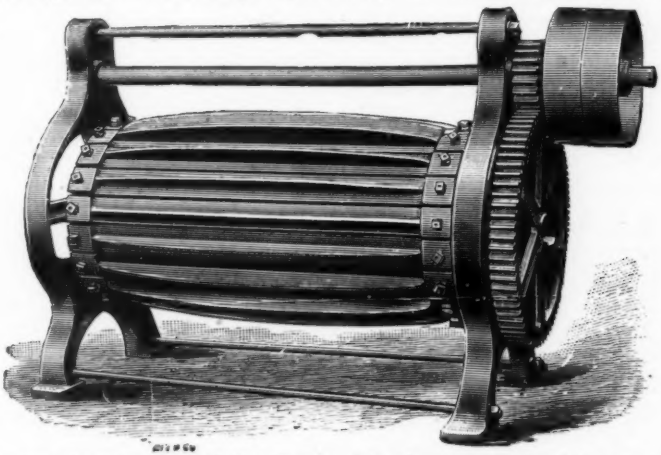
FOUNDRY EQUIPMENTS,

Composition Black Lead,

Plumbago, Core Gum, White Dust, and Coal Dust.

Ladles, Cupolas, Fire Bricks, Gannister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, &c.

IMPROVED FOUNDRY RATTLER or FETTLING DRUM.



These Machines are invaluable for a Foundry, doing a larger amount of work of a superior quality, in a much shorter time than can be done by hand, without skilled labour.

"Dear Sirs,—We have been using your best Blacking for a large number of years, and always use it on our large Ingot Moulds, which, as you know, we have made up to 85 tons in weight.

"Yours faithfully, THE BRIGHTSIDE FOUNDRY & ENGINEERING CO., LD."

The most successful Foundry Specialities are

THE PIFTIN SPECIALITIES.

The Piftin Specialities are in universal favour with Founders both large and small, and are in constant use throughout the World.

The reason of their great and continued success is that each Speciality handled by us is proved to be a practical success *before* it is placed on the market.

It costs us a lot of money, time, and trouble to ensure this, but then it enables us to fully satisfy our buyers, and we thereby gain what we aim at—The repeat orders of our numerous clientele, both at Home and Abroad.

If, therefore, you are wanting anything for your Foundry, you should get the best of its kind, which is the *PIFTIN.*

The Piftin High Pressure Blower

Over 80 have been supplied to H M. Government.

The Piftin Portable Mould Drier

In use throughout the World, including the principal British and Continental Foundries.

The Piftin Sand Renovating System

Saves 80% of the yearly sand Bill.

The Piftin Sand Mixing Machine

The most efficient machine on market.

The Piftin Sand Blast Machinery

Adapted for all purposes.

Up-to-date in every respect. The most efficient, most simple, and most easily worked of any apparatus on the market. Saves the entire cost in the first few months.

For further particulars apply to

PIFTIN LIMITED,

143, 145 & 147, ROSEBERY AVENUE,

PLEASE NOTE NEW ADDRESS. LONDON, E.C.

SITUATIONS VACANT & WANTED

WANTED, Experienced Managing Foreman for malleable cast-iron works.—Write, H.W.S., PARKER FOUNDRY CO., Derby.

FOR SALE AND WANTED.

FOR SALE, "Root's" Patent Foundry Blowers, &c.

No. 2 size by	"Thwaites"	8 in. outlet	£22.
No. 1 ,,	"Allday's"	7 in. ,,	£20.
No. 1A ,,	,,	6 in. ,,	£20.
No. 3 ,,	"Wilkinson"	6 in. ,,	£17.

Two 7 ft. by 4 ft. Vertical Boilers, as new, each... ... ... £34.
For full details address J. LIGHT, Wolverhampton.

WANTED, Complete Working Drawing of 5-ton Geared Foundry Ladle—Address, Box 580, Offices of THE FOUNDRY TRADES JOURNAL, 165, Strand, London. W.C.

FOR SALE, "Tabor" Moulding Machine, pneumatic power ramming to take pattern plates, 24 in. by 48 in., almost new, perfect condition, a bargain.—Apply, STEEL & GARLAND, LTD., Worksop, Notts.

EVERY IRONFOUNDRY should use Hall's Improved Centrifugal Sand Grinder and Mixer, which utilise the waste sand from the Foundry, and makes it in the best possible condition for Moulding High Class Castings. Capacity 4 tons per hour. Price and Particulars, apply to J. S. HALL & CO., LTD., Midland Ironworks, Newark on-Trent.

FOUNDRY COKE.—Highest quality Durham and other descriptions.—Apply to JOHN GOTHARD & SONS, Chesterfield.

ANTHRACITE.—Specially prepared Fuel for every kind of Suction and Pressure Gas Plant.—Apply to JOHN GOTHARD & SONS, Chesterfield.

CUPOLA LININGS.

HIGH-CLASS QUALITY

FIRE BRICKS

Made from specially selected clays.

BEST CRUCIBLE CLAYS.

Blast Furnace, Hot Air Stove, Boiler Seating, Flue Cover, and other Best Fire Bricks.

JOHN HALL & CO.,

OF STOURBRIDGE, LTD.,

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NEWEST AND BEST WASH FOR STEEL FOUNDERS

PLASTIC CUPOLA GANISTER.

FINEST MATERIAL FOR LINING CUPOLAS AND FURNACES AND SETTING FIRE-CLAY BRICKS.

SPECIAL **STEEL MOULDERS' COMPO.**

STEPHENS & CO., Kidwelly.

FOUNDRY EQUIPMENT.

PATENT CORE MAKING MACHINES

No linseed oil or flour required.

NEW PORTABLE MOULD DRIERS

Moulds dried on the spot in an hour to one hour and a half.

J. W. & C. J. **PHILLIPS,**

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COLD BLAST PIG-IRON.

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JAMES DOUGALL & SONS, LTD.,
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Foundry Specialists.

GANISTER, FIREBRICKS, GANISTER BRICKS, FIRECLAY,
Of the Highest Qualities.

If you are troubled with Defective Fire-Resisting Materials write for Prices.

SHIPPING PORTS:
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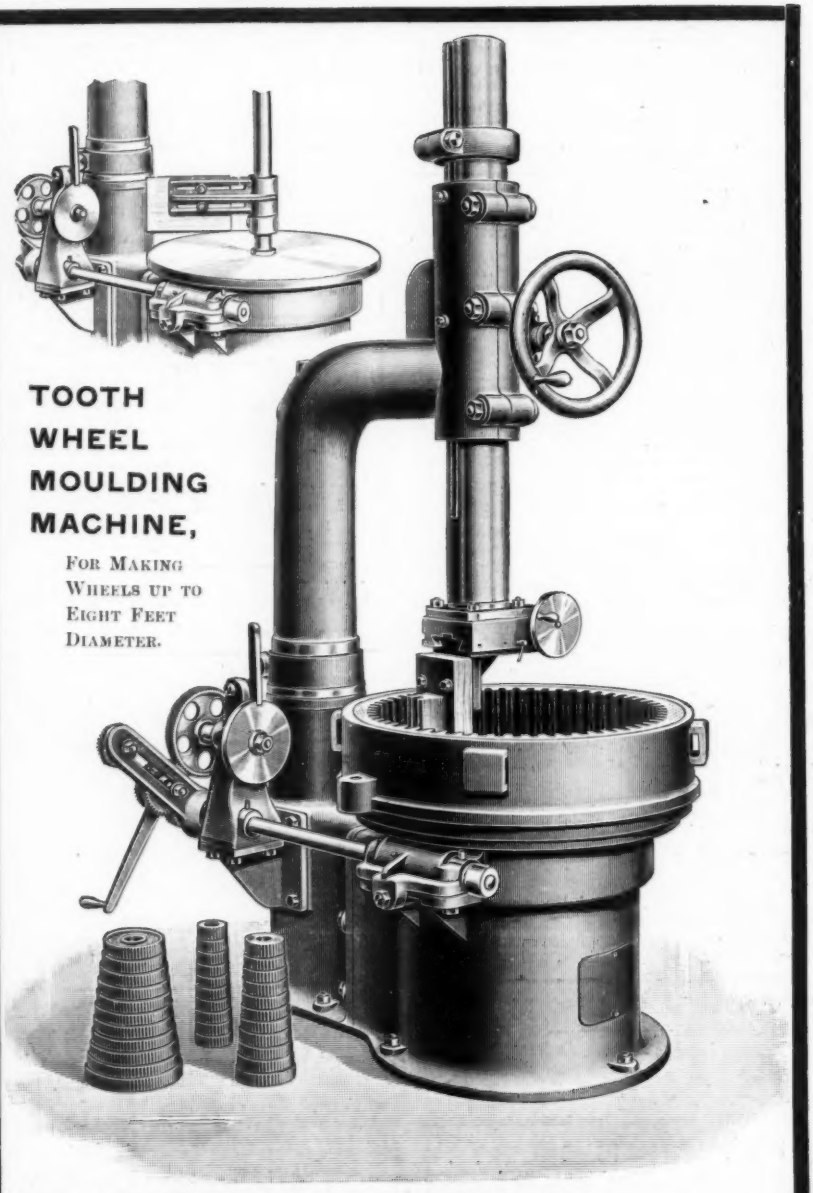

TOOTH WHEEL MOULDING MACHINE,

FOR MAKING WHEELS UP TO EIGHT FEET DIAMETER.

THE LONDON EMERY WORKS CO., DEPT. C.,
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AIR COMPRESSORS.

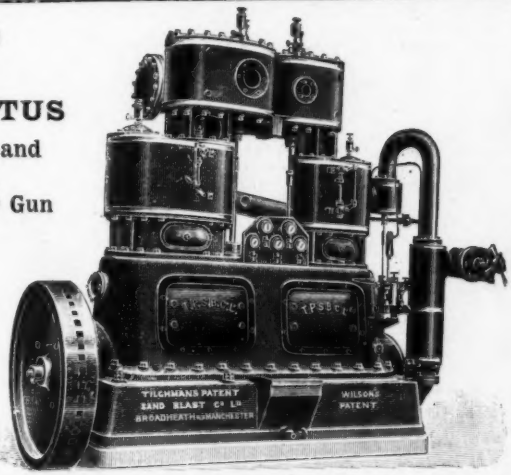
Other Specialities:

SAND BLAST APPARATUS

for cleaning large and small Castings, either Steel, Iron or Gun Metal.

PORTABLE MOULD DRIERS.

Catalogues on application.



Tilghman's Patent Sand Blast Company, Ltd.,
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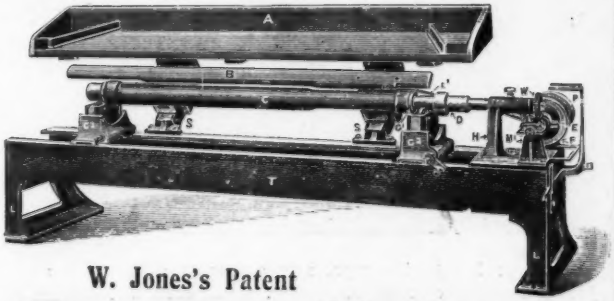
Pipe Foundry Practice

For Pipe Cores, 18 ft. long and 2 in. to 20 in. diameter.



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CORE FORMING MACHINE

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Makers of

FOUNDRY CUPOLAS of all Types,
CHARGING PLATFORMS,
HOISTS,
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CORE STOVE DOORS and
BOGIES,
&c.

The above Illustration represents a Cupola with spark arrester which we have just made and erected for Messrs. BENNETT'S IRONFOUNDRY CO., LTD., at their new works in GREEN LANE, HEATON NORRIS, STOCKPORT, and which is 45 feet high by 6 feet in diameter.

Messrs. Bennett's have at present in use at their ARDWICK works one of our Cupolas, which we supplied to them **23 years ago,** and although it has been in **constant use** ever since, it is still in good condition and giving **satisfactory results.**

FIRST CLASS PATTERN PLATES

are now being made by moulders in foundries, with

WHITE'S PATTERN PLATE APPARATUS

without the aid of any expensive machine tools.

No method of making repetition work in foundries **is complete without** a simple ready system of making pattern plates as required for either hand or machine moulding.

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Which is now being used by most of the leading makers in England and Scotland. Sample for trial sent free of charge, carriage paid.

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Cog Wheel Brand
Phosphor Bronze Alloys.
Phosphor Tin (5%).
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For High Temperatures.

Also Special Grades for
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BRASS FURNACES.

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38½"
McNEIL'S
PATENT UNBREAKABLE
STEEL LADLES
These Ladles are manufactured by a patented process, each from a single steel plate without weld or rivet. They are extremely light, being at the same time the strongest and most durable in the market. Ladles to contain 56 lb. of metal only weigh about 7 lb. each. They are made of all capacities from 30 lb. to 60 cwt., with or without lips; also mounted or unmounted. They are also suitable for chemical and metallurgical processes. List of sections and prices on application t
CHAS. McNEIL.
36
KINNING PARK IRONWORKS,
GLASGOW.
32½"

Can also be made in Aluminium.

NEW MOULDING MACHINE.

PICKLES' PATENT.

ASK FOR LIST AND FULL PARTICULARS.

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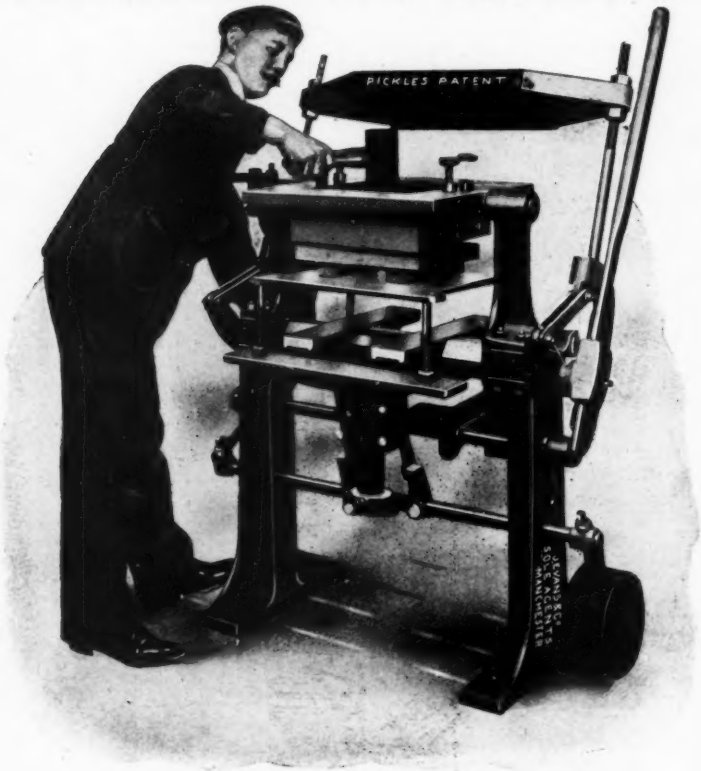

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